JOURNAL

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THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

SEPTEMBER, 1855.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On a System of Telephonic Signals for Avoiding Collisions at Sea. Communicated by CHARLES H. HASWELL, C. and M. E.

Having received and considered the communications of Professor D. H. Mahan, of the U. S. Military Academy, and of Lieut. W. T. Bartlett, U. S. N., regarding precautionary measures to be observed by steamers at sea, when running in an obscured atmosphere; I have to present to your notice the following reply thereto, together with my own views as to the precautions to be observed in such cases:

In the communication of Professor Mahan, it is proposed to resort to the use of blasts from a steam whistle in systematic connexion with the vibrations of a gong, which being interpreted by reference to a key in possession of navigators, the position and course of a steamer may be readily ascertained; and in that of Lieut. Bartlett, the same end is proposed to be attained by blasts from a steam whistle, peculiar to each of the cardinal points of the compass.

Both of these systems are practicable, but objectionable in some of their features, and for the following reasons:

1st. That of Professor Mahan is unnecessarily complicated by the introduction of a gong, and the interval between the signals is so short, as to render attention to them unceasing, whilst the frequent occurrence of them would be more objectionable of endurance to passengers and crew than the risk of collision.

2d. That of Lieut. Bartlett is the least objectionable of the two, but

alike to the first named, the time between the signals is too short and the number of the blasts unnecessarily extended, and therefore liable to induce confusion and consequent error.

A reference to the facts of the late loss of the U. S. mail steamer *Arctic*, to the existing elements of precaution and necessity for it, to guard against like occurrences, presents the following details:

1st. The end desired to be attained is the increased security of lives and of property from the collision of steamers with each other and with sailing vessels.

2d. The only practicable method that suggests itself is, that of the navigators of steam vessels to avail themselves of the very effective means of a steam whistle, an instrument with which nearly all of our steamers are now supplied, and where it is not in use, the cost involved in its purchase and attachment is so inconsiderable, its utility considered, that it cannot present any objectionable feature to its adoption: and with sailing vessels, when such an instrument is not available, the watch bell can be resorted to.

3d. Signals are only necessary to guard navigators from the collision of their vessels, one with another, within the space of half a mile.

4th. The highest speed yet attained by steamers and sailing vessels at sea, or likely to be attained by them, *in an obscured atmosphere*, within many years, would not justify any assumption of a higher combined velocity to two vessels approaching each other upon opposite courses, than that of thirty-six miles (knots) per hour; a half of a mile, therefore, would be made by them in the space of fifty seconds; and when the speed was altogether upon the part of one vessel, as in the cases of the sailing vessel being becalmed, or the steamer crippled or disabled, the speed would not exceed twenty miles, and the time consumed then in running half a mile would be one minute and a half.

5th. The board of supervising inspectors of steam vessels, appointed under the act of Congress of 30th August, 1852, have ordered, that the pilots of all steam vessels navigating seas, gulfs, bays, lakes, or rivers, of the United States, when their vessels are running in a fog, "shall cause a bell to be struck, or the steam whistle to be sounded, every two minutes." No provisions are here required from navigators as a precaution from collision when their vessels are at anchor, and a critical construction of the regulation might, with those who were indisposed to practice the precaution required, furnish a justification for noncompliance with it, when the atmosphere was obscured by snow, rain, or mist. Further, the regulation is confined to the maritime jurisdiction of the United States.

6th. The variations of time on board of all vessels, would have the effect, in an average of cases, of reducing the intervals between the sounding of signals one-half.

With these elements before me, then, I present the following regulations to be observed by navigators of steam and sailing vessels, during the existence of an obscured atmosphere:

1st. All steam and sailing vessels to be provided with watch bells, and all steamers to be further fitted with a steam whistle of sufficient capacity to be heard in calm weather, five miles.

2d. Navigators of steamers and sailing vessels, without the maritime jurisdiction of the United States, when running, lying to, or at anchor, to give one full stroke of their bell or blast from their steam whistle, as they may be provided and prepared to, every five minutes, and when they shall hear either of these signals from another vessel, they shall immediately telephone their course or position after the following rules:

When running or heading between north-west and north-east, with one stroke of their bell or one blast upon their steam whistle, or when running as above between north-east and south-east, with two distinct strokes or blasts, and when between south-east and south-west, with three distinct strokes or blasts, and when between south-west and north-west, with four distinct strokes or blasts, and they shall continue their signals every two and one-half minutes, until they shall have passed beyond the risk of collision with each other.

3d. Navigators of steamers and sailing vessels, when entering into a harbor, are to give two continuous strokes of their watch bell, or blasts from the steam whistle, every five minutes.

4th. When navigators of steamers and sailing vessels have entered into a harbor, they are to conform to the maritime regulations of it, and where it is known that none exist they are to be guided by the existing regulations of the United States as here given.

5th. When it may be necessary in the opinion of any one or both of the navigators, of two vessels approaching each other, to know the courses of each other, nearer than that provided for as above; as in the case of a vessel running upon an extreme of the range of eight points embraced in a signal, and another either upon the other extreme of the range of the same signal or upon the near extreme of the range of the signal contiguous to it; the navigator who desires to know the course of the vessel approaching him, to give his course as above directed, and immediately thereafter should give the signal of the course in the range nearest to his, in short and rapid strokes of his bell or blasts from his whistle as he may be provided to do, and the other is to reply in like manner and to give the course in the range nearest to his. Thus, if the course of a steamer was between east and south-east, the signal would be two distinct strokes or blasts, and immediately thereafter three rapid strokes or blasts, signifying that her course, although within the range of N. E. and S. E., approached to that of S. E.

The utility of this system over that of one where the course of a vessel is being constantly indicated, is, that it reduces the number of signals and thereby removes from it the objectionable features of unnecessary labor, to those in charge of the duty, and of unnecessary disturbance to the passengers and crew, whilst it retains the whole of the essential feature, that of the indication of the courses of vessels in proximity with each other.

In the operation of this system however, full success is neither claimed or anticipated; neither is it conceded to any system depending alone upon telephonic signals, for in order to meet some cases of which the following are fair instances, a light, of sufficient power to reflect its rays in a fog or mist, at a distance of a quarter of a mile, must be resorted to and placed upon the bows of all vessels.

The instances alluded to, or such as would seem to render the precaution of even a steam whistle inoperative, are:—

1st. When a sailing vessel is "lying to" in heavy thick weather, and a steamer approaches her on the course of her lee beam, the watch of the sailing vessel may be unable either to see or hear the steamer until she is too close upon them to be avoided, in the inert condition of "lying to," and the watch of the steamer unable either to see the sailing vessel, or to hear her watch bell (it being of the usual size carried in vessels), they cannot discover their proximity to another vessel, until it is too late at their rate of speed to avoid collision, they only under the immediate command of the helm.

2d. The times of two vessels being alike, their signals may be given identical in time and duration, and if approaching each other at a high velocity, collision would be difficult of avoidance.

3d. The steam whistle of a steamer may become temporarily inoperative from a fracture of its pipe or other causes, and the watches of one or both vessels may neglect a signal.

I am of the opinion, therefore, that no system of signals adapted to an obscured atmosphere at sea can be always reliable, without the introduction of a light of great power, placed so as to be seen only from ahead of the vessel carrying it, and in connexion with this view of the requirements of navigation, I am gratified at being able to advise you that a light designed to meet this purpose, has just been brought to my notice, and that it is one holding forth much promise of its practicability.

I am, respectfully, your obedient servant,

CHARLES H. HASWELL.

To WALTER R. JONES, Esq.,
President Board of Underwriters, New York.

New York, October 30th, 1854.

For the Journal of the Franklin Institute.

On Errors Committed by Writers on Mechanical Engineering.

By WILLIAM TRURAN, Esq.

The March number of the *Journal of the Franklin Institute*, (Vol. XXIX, p. 145,) contains an article on errors committed by Writers on Mechanical Engineering. The subject being a refutation of the assumed gain of power attending a certain disposition of the handles of a windlass or other similar machine, actuated by manual labor, written after a lengthy practical experience on the matter, and, therefore, entitled to a favorable consideration from theoretical writers. In it, mention was made of an error committed by the late editor of the *London Mechanics' Magazine*, in stating that "the force of two men rightly applied to a crank, is more than twice one in the proportion of 70 to 60." This remark has called forth a reply from the present editor, Mr. R. A. Brooman, so thoroughly at variance with its professed object, that we have to request permission to answer a few of his allegations.

Mr. Brooman considers it necessary, to correct our version of Desagu-

lier's erroneous assertion in these words, "what he states is, that if one man working at one handle of a windlass can raise 30 pounds *with a certain degree of ease*,* then two men working with handles at right angles, can raise 70 pounds *with a greater degree of ease*." Now, the plain interpretation of this is, if one man with a given amount of exertion and fatigue can raise 30 pounds, two men with handles at right angles, each of them applying a similar amount of exertion, can raise considerably more than 70 pounds. Mr. Brooman seems to have some doubts as to its absolute correctness, for he states, "we do not at this moment purpose to contend that this somewhat loose statement is true," although the reader will perceive that its truth, or otherwise, is the sole matter in dispute, and one which in common fairness he ought to have settled; but instead of so doing, he endeavors to prove by our statements, that "since the force exerted by a man at the handle of a windlass is constantly varying, it is clear that the greatest weight which he can raise, is determined by the minimum force." So far correct; but foreseeing that it would destroy his case, Mr. B. considers it advisable to say nothing as to the relative position of the second man with handles at right angles to the first, merely assuming that he is then exerting a maximum force. It is on this point that the whole matter hinges. We have shown by a diagram, that in disposing the handles at right angles, the two men simultaneously arrive at the portion of the revolution wherein they have the least ability to exert a maximum force, and further, in support of our position, we adduced the known fact (one which Mr. Brooman can hardly be ignorant of) that in practice, workmen left to their own discretion invariably set the handles of windlasses diametrically opposite to each other.

The arguments advanced by Mr. Brooman in support of his untenable position, are as far-fetched as ridiculous. "We recommend Mr. Truran to furnish himself with a friend of equal strength with himself, and a windlass or crane with a very long handle, so that he shall be thrown into inconvenient postures in turning it, and be able to exert but a small force in some positions—say when the handle is moving through the upper arc of its path, at such a height above his head that he can but just grasp it." Where, we would ask, is the windlass or crane with handles at any portion of the revolution high above the heads of the men working them? And further, we would ask, what force can a man exert with the handle in the unheard-of position that Mr. Brooman finds it convenient to place it. This argument of Mr. B.'s is a most unfortunate one, and shows his utter inability to deal fairly with the matter.

Continuing in the same spirit, his remarks, Mr. Brooman says, "allowing for the laxity, which even editors sometimes exhibit in private correspondence, the statement of our predecessor is undoubtedly true, although it would have been better had he avoided the mention of a given proportion." Thus in the same breath it is asserted, that there is a positive gain by disposing the handles of a windlass at right angles, but it is not advisable to state the amount of such gain (we presume lest it might be incorrect); altogether a curious way of corroborating a statement that requires some tangible facts for its support. Is the gain of such an ephemeral character that it can neither be measured nor calculated? The

* The Italics are in the original of Mr. Brooman.

London Mechanics' Magazine is profuse in its mathematical demonstrations. Here was a fit subject for displaying its abilities, but for the best of all reasons, that no mathematical investigation would avail, the opportunity was not embraced.

What is meant by the "laxity, which even editors sometimes exhibit in private correspondence?" Is it that Mr. Brooman in his capacity of civil engineer would be justified in giving an erroneous opinion to a client who paid him handsomely for it, but in his editorial capacity would not be justified in publishing to the world a similar inaccurate statement? To us it looks very like an admission that his predecessor was a little in error, which he is most anxious to excuse.

In order farther to strengthen his position as an advocate for the gain of power when the cranks are disposed at right angles, Mr. Brooman takes the liberty of perverting our remarks to suit his peculiar views. He says that the statement of his predecessor was to the effect "that from two men rightly applied, a greater result may be obtained than from the same two wrongly applied."

Now, the extract we gave from Mr. Robertson's letter, was copied literally, and nowhere contains the saving clause "wrongly" which Mr. Brooman wishes to introduce, nor was it intended to be thus qualified, for in subsequent letters, the gain of power is steadfastly adhered to. It will be recollected that the purport of our remarks, was not whether the strength of men was rightly or wrongly applied when applied to windlasses, but to contradict the oft repeated assertion that by disposing the handles at right angles there was a gain of power—by which is understood the ability to raise a heavier weight with the same degree of exertion; and further, they were intended to apply to windlasses as usually constructed, not to exceptional modifications never met with in practice; therefore, Mr. Brooman's line of defence is altogether wide of the question.

Mr. Brooman's advice to the writer to obtain correct ideas on the matter "by applying to any of those obliging and communicative individuals who, either in America or in this country, devote their energies to the elevation of bales, the dredging of mud, or any similar occupation," is on a par with the other portions of his reply, and however witty he may consider this remark of his, the reader will perceive that it is strangely at variance with the respectability he claims for his *Magazine*, and the solicitude which he manifests for the character of the *Journal of the Franklin Institute.*

July 10th, 1855.

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*Durability of Railroad Iron.**

The complaints respecting the inferior quality of recently manufactured rails, naturally attributable to the attempts made by companies to reduce the price, have attracted attention both in this country and in the United States, and have led to some practical and scientific inquiries. On the first introduction of railroads, it was confidently asserted by their promoters, that the rails would last for indefinite periods, but experience soon

* From the London Mining Journal, No. 1027.

demonstrated that railway bars were subject to lamination and disintegration, from the repeated rolling of heavy loads. Their duration, in some instances, has not exceeded two or three years; and in some of the earliest constructed lines in England, the rails have been changed twice, or even three times, since their opening. Opportunities have, accordingly, presented themselves to the engineers on these lines, of ascertaining the actual powers of endurance of iron rails, and of calculating the amount and extent of traffic which they are capable of withstanding under the varied circumstances to which they are exposed. Where the conditions are favorable, and the bars themselves perfectly sound, it is believed that the traffic which rails of ordinary quality are capable of bearing will not fall very short of 20,000,000 tons. The rails laid down on many of our railways have not, however, carried one-fourth of this traffic; and large quantities have been, in some instances, renewed which have not borne a tenth of that weight. Well recorded obervations on this subject are much to be desired, and would prove of the greatest benefit, not only to railroad companies and their shareholders, but also to engineers, and even to the iron trade in general. In directing attention to the subject, we need not remind the public that this Journal is at the service of those who are enabled to furnish scientific or practical information in reference to it.

A paper has appeared in a recent number of the *Journal of the Franklin Institute*, of Pennsylvania, "On the Durability of Railroad Iron," by Mr. William Truran, in which the question has been partially discussed, and some details supplied respecting the wear and tear of rails on some railways. Much of the information thus collected has from time to time appeared in the columns of this Journal, and although of value in a concentrated form, cannot be new to the scientific or practical English engineer. It is observable, however, that the paper is confined to some local lines, and does not refer to the great trunk railways of this country. They are, of course, the lines from which general deductions can be most safely derived, and in which the most perfect means exist of recording full and accurate information. Mr. Truran has drawn certain conclusions from the limited examples which he has been enabled to give, of the duration of railway rails under different conditions of laying and working, and he remarks, that in every instance where, in the construction of the permanent way, solidity had not been obtained by the employment of adequate sleepers, the destruction of rails had been most rapid. The greater duration, on the other hand, may be attributed to the use of heavy rails, to the wagons and carriages having bearing springs, and to a well constructed and carefully maintained permanent way. Favorable instances of durability have been found to arise from favorable grades, but the absence of bearing-springs has been found to have a prejudicial effect on rails, and to have greatly lessened their duration. When the quality of the metal used has been inferior, and the nature of the fastening employed defective, unfavorable results might be naturally expected. It has, we are informed, been found in practice that the cost of labor and materials, in supplying and replacing unsound bars, and the ultimate expenses incidental to the entire renewal of the rails, of course irrespective of their first cost, is generally equivalent to the value of the old metal obtained. It is obvious that this investigation opens a field of curious and interesting

inquiry, and our specially directing attention to it may, perhaps, lead to more perfect arrangements for the collection of future materials.

Every advance in the manufacture of rails is a matter of national importance, and we feel proud to acknowledge that Wales is taking the lead in practical improvement. The heaviest rail ever made has been manufactured at the Rhymney Works, Monmouthshire—a Barlow rail, 52 feet 6 inches in length, 90 lbs. to the yard, being a total weight of 1575 lbs. The longest rail ever made, a double-headed rail, 60 feet long, 75 lbs. to the yard, total weight 1500 lbs. has just been manufactured at Tredegar Works, also in Monmouthshire. It is difficult to decide which ought to bear the palm, the Rhymney rail being $\frac{1}{20}$th heavier than the Tredegar rail, and the Tredegar rail being $\frac{1}{4}$th longer than the Rhymney rail; but it must be remembered that a double-headed rail is more difficult to be manufactured than a Barlow rail. The reduction of duty on rails imported from this country into France, while illustrating the enlightened policy of the French Emperor, has given fresh impetus to the manufacture in England; and we believe this country is likely still to maintain her superiority. We cannot conclude without recording the public spirit evinced by the workmen at Tredegar, who, having finished their week's work (about 700 tons of rails), on learning that it was contemplated to make a long rail, volunteered, without remuneration, to manufacture the longest rail in the world. The rail was accordingly wrought, and heated in one of the ordinary furnaces, and, after a week's toil, was finished by the gratuitous labor of the workmen, whose independence thus sought to maintain the pre-eminence of their country.

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*Ship Canal across the Isthmus of Suez.**

M. de Lesseps is now on his return from Egypt to Paris, probably to make the necessary arrangements for carrying out the project with which he has been so long occupied, and for which, it is believed, he has at last obtained the consent of the Ottoman Porte, that of the Viceroy of Egypt having been long ago and very readily given. This project is the important one of cutting a ship canal through the Isthmus of Suez, and thus making an expeditious and easy direct passage for ships of large size from the Mediterranean into the Indian Seas. The line originally traced out for this canal was from Tineh to Suez, the narrowest point of the Isthmus; but this, from a congregation of difficulties not then sufficiently studied, and from data and calculations erroneously founded, it was deemed necessary to abandon; the more so as the cost could not be less than 300 millions of francs, whereas that for the canal of greater length now proposed is estimated at no more than 240 millions. The establishment of a canal at the narrowest part of the Isthmus is besides surrounded with such difficulties of execution that the authors of the project now approved of by the Pacha of Egypt, have decided in preference of the line by Alexandria and Cairo. The port of Alexandria and the roadstead of Aboukir are exempt from the obstacles to navigation which the Nile creates north-east of the Delta. A current running along shore from west to

*From the Lond. Civ. Eng. and Arch's. Jour. July, 1855.

east carries away from Alexandria the mud brought down by the river, and keeps the waters of this part of Egypt clear and deep. By opening the canal at Alexandria the enterprise is saved the considerable and costly works necessary at Tineh. Canals of communication between the Mediterranean and Indian seas not only existed from the most distant period, but vestiges of them are still found, agreeing with the plan now proposed. There was, however, a very important difference between the ancient canal and that now in question; which is, that the first was almost exclusively devoted to internal navigation, and probably had but little depth of water. The present dimensions of the English ships trading between India and Europe, oblige the engineers to enlarge the proportions of the projected canal. It is proposed to admit of the passage of large ships of war, and to maintain the necessary depth of water. The difficulty does not consist in the works to be executed for constructing the canal and locks, and for finishing all the other requisites, but in finding the means for feeding the canal to a depth for large ships. After extended surveys it has been found that the water supply cannot so readily be procured from the two seas as had been conceived, and that recourse can be more easily and conveniently had to the waters of the Nile, for that river has been ascertained, contrary to former belief, to have an elevation considerably above that of the sea.

AMERICAN PATENTS.

List of American Patents which issued from July 10, *to July* 31, 1855, (*inclusive*,) *with Exemplifications.*

JULY 10.

51. For an *Improvement in Apparatus for Draining Sugar;* John Aspinal, London, England.

Claim.—"The combination of the porous carrier conveying a thin layer of the sugar to be drained with the exhausted chamber, having apertures covered by the carrier, whereby the said sugar is exposed to atmospheric pressure while passing said apertures."

52. For an *Improvement in Ventilating Railroad Cars;* Charles Atwood, Birmingham, Connecticut.

Claim.—"The method of constructing, attaching, and using the flexible connexions. Also, the combination of the flexible connexions with any suitable method of receiving the air at the front end of the tender."

53. For an *Improved Method of Raising and Lowering the Cutters of Harvesters;* Jonathan F. Barrett, North Granville, New York.

Claim.—"Connecting the front of the frame with a lever for effecting the elevation of the cutters, for the passage of obstacles by the drivers' foot."

54. For an *Improvement in Processes for Treating Wool;* Thomas Barrows, Dedham, Massachusetts.

Claim.—"The application of nitre, or any of its equivalent salts, to wool in a warm bath, for the purpose of restoring wool when it has become changed, as well as for cleansing, softening, and preparing it, so as to better adapt it to receive dyes and being finished in fabrics."

55. For an *Automatic Machine for Turning Ship Spars, &c.;* William Blackburn, Jersey City, New Jersey.

Claim.—"1st, The combination and arrangement of the gears, s s and *d*, with the

self-adjusting rests, or mechanism substantially the same, for holding the stick, whether straight or tapering, always firm and steady during the operation of turning. 2d, The combination of the chisel-holder, screw, and gear *d*, (or mechanism equivalent thereto,) for working the chisel-holder simultaneously with the self-adjusting rests."

56. For an *Improvement in Air and Steam Engines;* Francis Brown Blanchard, Waterville, Maine.

Claim.—"As arranged with the boiler and stack of tubes, or their equivalents, the two chambers, and their respective connexion pipes, such chambers, pipes, and stack of tubes being used for the purpose of regulating the temperature of the mixture of steam and gases. Also, in combination with the air pump and the furnace, the tubular air condenser, for the purpose of reducing the heat of the condensed air and relieving the air pump from back pressure. Also, combining with the coal feeder the distributing valve. Also, arranging hollow grates on an angle in combination with arranging them with and directly under a full supplying tube or hopper, so that the fuel dropped out of the latter and upon the inclined grates may be distributed by them."

57. For an *Improvement in Gas Regulators;* Saml. W. Brown, Lowell, Mass.

Claim.—"The lever, and valve, and knife edged guides or points of support, for sustaining and guiding the lever and valve, and the float, which are so arranged and operated by the pressure of gas within the float, as to apply great force to open the regulating valve, to overcome the sticking or adhesion of this valve to the top of the induction tube by the gas tar, and then to continue to open or close it in proportion to the number of lights which are being regulated, and the pressure of the gas through the induction tube, so as to regulate the burners nicely and evenly."

58. For an *Improvement in Lubricating Compounds;* Eleazar Brown, Jr., Binghamton, New York.

Claim.—"The use and application of saltpetre combined with common hard soap and fat salt pork, or any similar oleaginous animal substance, thereby forming an antifrictional refrigerating lubricating compound, adapted to the purpose of lubricating the journals of railroad cars, locomotive engines, and, also, the journals of all kinds of machinery."

59. For an *Improved Sun Shade;* S. N. Campbell, Elgin, Illinois.

Claim.—"Attaching a frame formed by the rods to a head band or to a cap, said frame being covered with any proper material."

60. For an *Improvement in Saddle Trees;* Daniel Campbell, Washington, D. C.

Claim.—"The combination of the side bars to the pommel and cantel by means of the springs."

61. For a *Device to allow Escape of Waste Water from Pump Barrels;* Jas. E. Crouk, Poughkeepsie, New York.

Claim.—"The valve placed over the outlet passages leading from the chambers, said valve being attached to a spring lever, H, which is acted upon by a sliding rod, so that said valve will be closed by merely grasping the handles of the sliding rod and lever, D, in operating the pump. The valve being opened when the handles are freed from the hand by the action of the spring, J."

62. For an *Improvement in Straw Cutters;* Lyman Clinton, North Haven, Conn.

Claim.—"Placing knives or cutters on the wings of two revolving arbors or shafts, when the edges of said wings have rebates cut in them, so as to form lips or ledges opposite the cutting edges of the knives or cutters."

63. For an *Improvement in Spark Arresters;* Daniel Deshon, 2d, Whitestown, N. Y.

Claim.—"The arrangement of the deflector at the base of the pipe, the curved flanch at the top, and the gauze or grating at the side."

64. For an *Improvement in Looms;* Rufus M. Dill, Holyoke, Massachusetts.

Claim.—"A sliding bar attached to the lay, having projections adapted to each shuttle of a series at its outer end, and actuated from the inner end by a groove attached to the frame of the loom."

65. For an *Improvement in Buckles;* Sheldon S. Hartshorn, Orange, Connecticut.

Claim.—"The manufacture of buckles composed of but two pieces."

66. For an *Improved Ship Pump;* John J. Heard, Boston, Massachusetts.

"The nature of the invention consists in an attachment to the ordinary pump, by which means it may be made to operate either upon the water in the well, or upon that in the bilge."

Claim.—"The attachment with its gate."

67. For an *Improvement in Fastenings for Carpets;* Enoch Jackman and Edwin G. Dunham, Portland, Maine.

Claim.—"The method of securing carpets to floors by the arrangement and application of a socket and pin, or a plate and pin so applied, that the friction which is caused by the contraction of the carpet, in canting the pin in the socket, may prevent the pin from slipping out of the socket, so that carpets may be put down and taken up at pleasure with nothing but the hand."

68. For an *Improvement in Slide Wrenches;* Benj. F. Joslyn, Worcester, Mass.

Claim.—"The nut surrounding both parts of the jaws and long enough to give the required motion, with a thread on its inside working in the edge of part B, the part A surrounding the part B with the slot, and the part B sliding in the part A, with a thread on its projecting edge to receive the nut."

69. For an *Improvement in Washing Machines;* Wright Lancaster, Harmony Township, Indiana.

Claim.—"The floating rods, claimed to be an improvement on any former machine, for their freedom of action, their adaptation to the washing and cleansing of cloths by friction, without damage to the finest fabric, and the facility and speed with which this process is performed."

70. For an *Improvement in Steam Boilers;* James Murphy, City of New York.

Claim.—"The combination beads, or their equivalents, on the tubes, grooving the surface of the tube sheets around or partly around the tube holes to receive the metal of the tube when riveted, by means of which, I am enabled more effectually to secure tight and strong joints than by any other known method."

71. For an *Improvement in Machines for Pulverizing Clay;* John O'Neil, Kingston, New York.

Claim.—"The combination of the spring blades with the ridged surface of the cylinder against which they act. Also, the combination of the aperture in the depressed part of one or more of the ridges with the spring blades, which eject or force out the stones. Also, the combination of the cutting or pulverizing blades with the ridged surface of the cylinder. Also, the perforated or grated door and slide, for the purpose of regulating the discharge of tempered clay."

72. For an *Improved Machine for Cutting Screws on Bedsteads;* Orson Parkhurst and Daniel Bullock, Cohoes, New York.

Claim.—"Arranging and operating the rotary cutters at an angle, so that we can traverse them parallel to the rail and cut under the concave shoulder."

73. For an *Improvement in Harvesters;* Isaac Irvine Hite, Assignor to Washington F. Pagett, White Post, Virginia.

Claim.—"The combination of a raker's seat or stand with McCormick's machine for cutting grain and gathering it upon a platform."

74. For an *Improvement in Saw-Sets;* F. A. Parker, Shaftsbury, Vermont.

Claim.—"The arrangement of the circular spring, the adjustable bar, and the connecting rods."

75. For an *Improvement in Attaching Cast Point to Steel Mould Boards of Ploughs;* Adonijah Peacock and Simeon Peacock, Cincinnati, Ohio.

"We claim nothing new in the form of the solid cast metal point which we use, except the recess or shoulder at B C, fig. 1, for the purpose of attaching the steel part of the mould board to the cast point. Or in the steel mould board which we use, except

cutting the point off at B C, fig. 2, which is generally done at a distance of from six to eight inches from A, fig. 1, for the purpose of attaching to the cast point at B C."

Claim.—"The use of a solid cast metal point in connexion with steel or other wrought metal mould boards for ploughs, when united therewith, as described, or in any way equivalent thereto, so as to form of the two parts a mould board, the greater part of whose surface is steel or other wrought metal, and the point or front part of solid cast metal as a wearing point."

76. For an *Improvement in Rope and Cordage Machines;* Saml. Pearson, Jr., and Wm. H. Gardner, Roxbury, Massachusetts.

Claim.—"Arranging two or more twisting fliers, or two or more series of the same, with the twisting axes of revolution of one of them in line with the others respectively, and combining with each two fliers in line, hollow tubular necks (for the reception and support of yarn or strands from the bobbin), and a contrivance or contrivances for either uniting or disconnecting such necks, so that the fliers of several series thereof may be rotated together, or seperately, in order that when small sizes of rope are to be made, only one twisting flier or series may be put in operation, and when larger sizes of rope are to be manufactured, two or more twisting fliers or series thereof, may be combined and put in action together and with one laying flier. And, also, the rope or strap and its weight (or the equivalent thereof,) in combination with the conical laying tops, and the bearing plate."

77. For an *Improved Stave Machine;* Wm. Robinson, Augusta, Georgia.

Claim.—"The horizontally slotted spring knife holders combined with the guides, on the driver, so as to prevent the longitudinal movement of said holders during the driving operation, and cause the knife, at the completion of the cut, to force the stave into the lower bed and there hold it during the return stroke of the driver."

78. For an *Improved Vibrating Stop-Water for Ships and other Vessels;* Stephen Saunders, South Kingston, Rhode Island.

Claim.—"The combination of vibrating water stops with the hulls of vessels."

79. For an *Improvement in Counter Scales;* Fredk. Scheurer, City of New York.

Claim.—"The combination of two common beam scales with their inner arms connected together by links, to which the scale to receive the weights is attached, and their outer arms being connected by a frame to carry a float or straight scale to place the goods on, which are to be weighed."

80. For an *Improved Self-Regulating Water Packing for Pumps, &c.;* Joseph Smart, Philadelphia, Pennsylvania.

Claim.—"The application to pump caps of two stuffing boxes, so arranged one above the other, leaving a space or reservoir between them. Also, the manner of supplying the same with water by means of a small valve on the lower plate, or any other substantially the same, which will produce the intended effect."

81. For an *Improvement in Excavators;* Saml. W. Soule, Oswego, New York.

Claim.—"The frame placed on the crank of the axle or shaft, said frame being provided with buckets, one at each end, and enclosed by a box provided with transverse pins or rods."

82. For an *Improvement in Railroad Draw-Bridge Signals;* Simeon L. Shafford, deceased, late of Philadelphia, Pennsylvania.

Claim.—"The combination of the sliding signal frame, the signal boards, the signal lantern, and the signal lever. Also, the combination of the sliding signal frame, the signal boards, the signal lever, and the stop lock. Also, the combination of the latch lever, the signal lever, and the sliding plate."

83. For a *Machine for Cutting Legs for Pianos, Tables, &c.;* Andrew Stoeckel, City of New York.

Claim.—"The arrangement of the carriage with the vibrating frame attached, cutter disk, and cutters on the shaft and drum, placed in the swinging frame."

84. For an *Improved Gauge for Stair-Rails;* Chs. M. Swany, Richmond, Indiana.

Claim.—"The combination of the yielding or movable gauge and adjustable spring pencils."

85. For an *Improvement in Means for Increasing Draft in Locomotives;* Charles F. Thomas, Taunton, Massachusetts.

Claim.—"Combining with an air receiving mouth (arranged on the front end of the locomotive steam carriage) the chimney and smoke box, a secondary chimney and a concentric or surrounding air passage, whereby, when the steam carriage is in movement on the railway, a current of air may be caused to rush into the chimney and around above the mouth of the secondary chimney, and so as to aid in increasing the draft through the smoke tubes. And, also, in combination with the air deflector, the air passage, one or more closing valves or doors to the former, a covered deflector, and one or more other mouths or openings, and a closing contrivance or annular valve, v, the same being so applied as to enable the engine, either in moving forwards or backwards, to cause a current of air to enter its chimney. Also, the manner in which the valve c is made and applied to the passage, and the secondary chimney, in order that it may not only serve to diminish the discharging mouth of said passage, but deflect or contract the tubular current of air passing out of it, and so as to improve the draft of the same."

86. For an *Improvement in Brick Presses;* Stephen Ustick, Philadelphia, Pa.

Claim.—"1st, Combining the inner and outer peripheries of the rim of the revolving casting, shaped in segmental curves, eccentric with each other and with the centre of the shaft on which the casting is secured, in such relation to the upper and lower pistons for pressing the brick frames to which they are attached, and the friction wheels in said frames, as to cause the said segmental surfaces to operate on the friction wheels in their revolutions between the same, after the manner of a wedge, and thus avoid all liability of strain on the shaft, arising from the resistance of the pressure exerted in pressing the bricks by confining it to the body of metal between the two surfaces. 2d, Forming the faces of the pistons of longitudinal and transverse plates secured to the blocks or main body of the pistons by dove-tailed tongues or grooves, and wedges or gibs, and capable of being moved outward sideways and endways, so as to increase the area of the face of the pistons in case of wear. 3d, Forming a narrow slit in the centre or other part of the face of the piston, widening as it extends from the face, or not, as desired, and communicating with the outside of the pistons through their ends for allowing the air confined in the moulds to escape during the pressing of the clay into bricks."

87. For an *Improvement in Open Stirrups;* Orrin D. Vosmus, Mt. Sterling, Ky.

Claim.—"In combination with an open stirrup, a shank piece or arm, which passes between the stirrup straps and is held in place by a loop, or its equivalent."

88. For an *Improvement in Machines for Making Bolts;* Wm. E. Ward, Port Chester, New York.

Claim.—"The mode of operation for drawing or rolling to a cylindrical shape the end of the stem of square bolts, by means of the segment rollers in combination with the jaws, or equivalent therefor, on the sliding and rotating mandrel operated by an arrangement of mechanism, (as described,) or any equivalent therefor. Also, the mode of operation for taking the bolts from the feeding ways, or any equivalent device by which they may be supplied, and bring them to a horizontal or nearly horizontal position, by means of a vibrating wing which enters back of the bolt to be separated, and then vibrates to bring it to a horizontal or nearly horizontal position, in combination with the transferring pincers, or any equivalent therefor, by which they are transferred to the jaws, the required motion being imparted by an arrangement of mechanism (as described) or any equivalent therefor."

89. For an *Improvement in Sewing Machines;* James B. Woodruff, Washington, D. C.

Claim.—"1st, The arrangement of the needle shuttle and feeding arms, the connecting rods and pulley, with its wrist. 2d. Giving to the needle and the shuttle, such relative range of vibration, that at the time the shuttle is forward, the needle raised, and the tension upon the stitch the greatest, the distance between the eye of the needle and the eye of the shuttle and the stitch will be equal, thereby more effectually insuring an equal draft on both threads of the stitch within the body of the cloth. 3d, The combination of the feeding pawl with the feeding lever, to raise and lower the teeth of the pawl, and the inclined plane to vibrate them laterally. 4th, The combination with the feeding pawl of eccentric pin, a pointer, and an index or dial, graduated and numbered, whereby the machine can be adjusted to vary the length of the stitches at will to any

required number to the inch, and the number which the machine, as adjusted, will make, can at any time be observed without measurement or calculation, whether it be in operation or not."

90. For an *Improved Machine for Boring Posts and Pointing Rails;* John Young, Middletown, Maryland.

Claim.—"The reversible clamp and feed carriage in combination with the boring apparatus."

91. For an *Improved Self-Regulating Wind-Mill;* John Elgar, Baltimore, Md.

Claim.—"For a double set of wings attached to the arms of a wind wheel, and to act in the following manner: One set, those that are behind the arms in the line of rotation, are stationary in their plane, except in a storm, and furnish the means of a constant power, while the other set, those which are forward of the arms in the rotation of the wheel, are controlled by the wind and springs, so as to act automatically, even in the varying impulse of the wind, and relieving it from danger of injury in a storm."

92. For an *Improvement in Manufacturing Plate Glass from Cylinders;* William P. Walter, Philadelphia, Pennsylvania.

"The nature of the invention consists in flattening the glass cylinder by inserting the flattening instrument into the cylinder in the flattening furnace, and as the glass becomes soft from heat spreading out the wings of the instrument."

Claim.—"The forming of cylinder glass into an oblong shape with two flat sides by my improved flattening instrument."

93. For an *Improvement in Grain and Grass Harvesters;* Abner Whitely, Clark County, Ohio.

Claim.—"1st, So constructing the machine, that when the joint between the frame and tongue is flexible, the latter may, while the team is in motion, be raised and lowered in a sector of a circle whose centre is the finger bar, and thereby enable the operator at once to change the angle of cut, and this, irrespective of the mechanical device by which the motion is produced. 2d, The frame lever, provided with means of fixing its position at will, and linked to the main frame, in combination with the guiding slotted plate, as a means, when used with the flexible joint between the tongue and frame (for moving) of oscillating the frame about the finger bar as a centre, and thus varying the angle of cut, and when used with a rigid joint (for reaping) of raising and depressing the frame and finger bar. 3d, The combination with the links of the receding curve in the bottom of the slots in the plates in which the axis of the driving wheel plays, or of their equivalents respectively, for the purpose of enabling the driver to throw the cutter pinion out of gear. 4th, Suspending the main frame and its attachments from the driving shaft, in order, that whether used in reaping or mowing, the driving wheel and the finger bar may be independently adjustable, and the wheel may rise over obstructions or descend into depressions without altering the angle of cut, or otherwise affecting the cutters."

94. For an *Improved Self-Regulating Wind-Mill;* Benjamin Frantz, Assignor to John Phillips, Waynesborough, Pennsylvania.

Claim.—"Making a direct use of the wind itself for governing wind-mills by means of the wind lever, or its equivalent, connecting rods, collar, and strap rods, in combination with the wings."

95. For an *Improvement in Pneumatic Springs;* James F. Heyward, Wilmington, Del., Assignor to "The Delaware Car Spring Manufacturing Company."

"The nature of the invention consists in employing a fluid piston playing in an air chamber of any form, in such a manner, that when the fluid piston is forced against the contained air, it will compress the same to such an extent as to cause the resistance of its elasticity to balance the force applied. This fluid piston being moved through the intervention of any flexible inextensible water proof bottom securely fastened to the lower margin of the air chamber."

Claim.—"The method of rendering available the elasticity of æriform bodies in the construction of springs, bumpers, &c., by employing a fluid piston to effect their compression."

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96. For an *Improved Mode of Mounting Ordnance;* Chs. F. Brown, Warren, R. I.

Claim.—"Mounting a cannon or other piece of ordnance in a carriage of spherical, spheroidal, or other circular form, externally, which carriage is arranged to close the port or embrasure through which the piece works, but to turn freely therein in a horizontal or nearly horizontal direction, and which has an opening within it of suitable size and form to receive the gun and to allow it the necessary upward and downward swinging movement on its trunnions, whereby an efficient protection is afforded against the entrance of the enemy's shot or projectiles and the smoke of the discharge is excluded, and at the same time a desirable range in a lateral and vertical direction is maintained."

97. For an *Improvement in Lanterns;* C. H. Butterfield, South Lancaster, Mass.

Claim.—"Attaching a yielding or springing plate to the cap in combination with a match holder, so that lifting or throwing off the cap shall light a match placed so as to light the wick or lamp."

98. For an *Improvement in Window Blinds;* Washington H. Bixler, Easton, Pa.

Claim.—"The attachment of the two fusees connected by a cord, a spring being attached to the one fusee and the cords to the other fusee."

99. For an *Improvement in Nut Machines;* Robert H. Cole, St. Louis, Missouri.

Claim.—"Arranging the movable bottom of the nut box in such a manner in relation to the movements of the punch, that when a nut is being formed in the nut box its bottom will be forced against a yielding support for the purpose of insuring, in all cases, perfectly shaped nuts, and enabling the machine to adapt itself to bars of different thicknesses."

100. For an *Improvement in Invalid Bedsteads;* Benj. Eastman, Philadelphia, Pa.

Claim.—"The apparatus composed of shaft, arms, hooked cords, in combination with the detachable sacking and vertically moving shaft bearings."

101. For an *Improved Method of Operating Valves of Pumps;* Jacob Edson, Boston, Massachusetts.

Claim.—"1st, The peculiarly formed tripper in combination with the curved cap of the valve, by which means a single tripper is made to open both valves. 2d, The twisted partition, whereby the cylinder is divided into two water passages, which deliver the water upon the opposite side from that on which they receive it."

102. For an *Improvement in Machines for Forming Metal Tubes;* Edwin Ells, Ansonia, Connecticut.

Claim.—"Arranging the rotary bur-cutter between the preparatory U shaped die and the rollers, whereby the scarfing operation is performed at the same time as the forming operation, and the forming machinery serves to hold and feed the strip or skelp in a suitable manner to receive the scarfing operation."

103. For an *Improvement in Adjustable Vises;* John Fraser, City of New York.

Claim.—"Having the screw which passes through the movable jaw pass through a nut, so arranged as to turn and cause the screw and movable jaw to turn when wedged or taper-shaped articles are to be held, so that said jaw will conform to the obliquity or taper form of the articles, and cause them to be securely grasped by the jaws."

104. For an *Improvement in Harrows;* William Gourley, Clarke County, Va.

Claim.—"Arranging in connexion with a clod cutter a cutting roller, which may adapt itself to the inequalities of the ground, and also be made to throw its weight upon the clod cutter, or not, as desired."

105. For an *Improvement in Safety Railroad Drawbridges;* John K. Gamble and William P. Gamble, Philadelphia, Pennsylvania.

"The nature of the invention consists in a novel manner of combining and arranging the switch rail and inclined "sideling" with the drawbridge, whereby the switch rails can be unlocked and moved in connexion with the inclined "sideling" and locked simul-

taneous with the slightest opening of the draw, and again unlocked and thrown in connexion with the main tracks and locked simultaneously with the closing of the draw, or at the moment it is entirely closed."

Claim.—"The contrivances, or their equivalents, so arranged and combined as to constitute a safety railroad drawbridge."

106. For an *Improved Rosin Oil Lamp;* Francis Blake, Needham, Massachusetts.

Claim.—"1st, The air chamber within the lamp in connexion with the circuitous passage. 2d, The button I in combination with the button L and opening, whereby the quantity of air that is admitted to the interior of the flame is adjusted to the height of the button above the wick. 3d, The draft regulator."

107. For a *Fan Blower;* Joseph C. Gartley and Jacob Fox, Philadelphia, Pa.

"Its operation: When the blowing wheel is put in motion by some power applied to the pulley, the external air enters the circular opening on the side B, distributing itself through the air chamber between the slide B and blowing wheel, it is then taken up by the blades E, passing along between the blades, conical hub, D, and rim C, these discharging into the air chamber between the side K, and blowing wheel, then conducted from the air chamber by the pipes H, H, to I, and there discharging. We also claim, where an ordinary parallel hub is used, a circular plate or pieces of plate fastened to the hub and blades E, of blowing wheel, inclosing the greater portion of the side of blowing wheel towards the side K, to answer the same purpose for which the larger portion of the conical hub is intended, which is to prevent a central reacting current after it has passed through the blowing wheel."

Claim.—"The combination, in the manner set forth or shown, for the purposes named."

108. For an *Expanding Auger or Bit;* L. H. Gibbs, Washington, D. C.

Claim.—"The adjustable plate, with the rib, the lip, the index holes in it, combined with the auger, with slot, tapering pins, and set screw."

109. For an *Improvement in Ships Capstans;* John B. Holmes, Assignor to John R. Pratt, City of New York.

Claim.—"The arrangement of the stationary drum head in relation to the stationary base and spindle and movable body, the same being moved by gearing and cranks."

110. For an *Alarm Bedstead;* J. Carroll House, Lowville, New York,

Claim.—"The employment of the tilting frame or bed bottom, in combination with a suitable catch or series of catches connecting it with a clock, in such a manner as to be tilted at any required hour by the action of the clock."

111. For an *Improvement in Railroad Car Coupling;* Aaron G. Heckrotte, City of New York.

Claim.—"The method of releasing the tumbler by double branched sliding guards, combined with the dog bar, whereby the rigid attachment of the box is avoided, and the same rendered capable of attachment to the ordinary spring bumpers. (The invention here considered as an improvement on Bussey's patent of 17th July, 1847, is designed to obviate certain defects in that coupling.)"

112. For an *Improvement in Bedsteads;* Tyler Howe, Cambridgeport, Mass.

"The nature of the invention consists of a bed bottom that shall be perfectly elastic at every point and capable of yielding, so as to conform to the shape of the body, while, at the same time, the slats, of which it is composed, being supported by spring bearings near the middle of their length, do not sag in the centre."

Claim.—"The bed bottom, consisting essentially of the slats and the springs."

113. For an *Improvement in Bottle Fastenings;* Jules Jeannotat, Paterson, N. J.

Claim.—"Forcing a cushion of india rubber, or other suitable material, over or upon the mouth of the bottle by means of a lever inserted in a plate, D, which plate D, has flanches attached to it by rods or links. The plate D also having attached to it a plate G, to which the cushion is secured."

114. For an *Improvement in Trebling a Single Strand and Twisting Sewing Thread;* Harold Kelsea, North Branch, New Hampshire.

Claim.—"The combination of the endless band, its hitching heads or knobs, and the

stationary frame hitching knob, as applied together to the drum rollers and twisting mechanism, and made to operate so as to treble and enchain a strand."

115. For a *Wind-Mill;* J. S. Morgan, Highland, Illinois.

Claim.—"Connecting the weights to the wings or sails by means of the cords or chains, said wings or sails being arranged in pairs and connected by pinions."

116. For an *Improvement in Derricks;* Edward Mingay, Boston, Massachusetts.

Claim.—"Attaching to a derrick a lever having its fulcrum in the boom of the same, and actuated by a rope and windlass."

117. For an *Improvement in Apparatus for Heating Feed Water to Locomotive Engines;* David Mathew, Philadelphia, Pennsylvania.

"The nature of the invention consists in an arrangement of a tubular feed water heater, with sectional cones and short exhaust pipes, in relation to each other and to the smoke box, so that the heated gases in their course from the flues to the openings between the sectional cones, cause the heat to act directly against and around them, the exhaust pipes discharging into the low sectional cone and force the current up through sectional cones, causing the current to rush between each sectional cone."

Claim.—"The arrangement of the tubular heater, sectional cones, and short exhaust pipes in relation to each other."

118. For an *Improved Machine for Mortising Window Blinds;* Joseph A. Peabody, Lowell, Massachusetts.

Claim.—"The bar or carriage, x, which carries the blind stile, and which is moved by lever or otherwise, and the changeable and adjustable arms, or their mechanical equivalents, one end of each of them being connected to the bar, while their opposite ends are so connected (by pins or otherwise) to the machine that these arms are changeable and adjustable, so as to impart any desired angle to the mortises. Also, the carriage, B, or its equivalent, which may be vibrated or moved by lever or otherwise, for carrying a series of revolving mortising chisels, this carriage and the chisels attached to it, being so moved, that the chisels will form or cut all the angular mortises in one window blind stile at one operation."

119. For an *Improvement in Attaching Metallic Heels to India Rubber Soles;* S. T. Parmelee, New Brunswick, New Jersey.

Claim.—"Having the metallic rims or casings formed with recesses arranged in a proper way, so that the soft or plastic india rubber, mixed with the proper vulcanizing materials, may be fitted therein, and the rubber and rims or casings be permanently locked together by subjecting the rubber to steam heat and vulcanizing it when fitted within the rims or casings."

120. For an *Improved Wrecking Pump (rotary;)* Oliver Palmer, Buffalo, N. Y.

"The nature of the invention is, 1st, The combination of an angular arm or bucket, so made as to press the water outward from the shaft, with a spiral partition in the suction pipe, which gives the water an initiatory rotation in the direction contrary to that in which the arms revolve. 2d, In combination with the horizontally angular arm and spiral plate, a curve in the vertical face of the bucket, made to induce the water to rise upon the bucket, and more effectually hold it upon it while it is within range of the circle of the arms."

Claim—"The combination of the arms, constructed in any equivalent manner, with the spiral partition."

121. For an *Improvement in Railroad Car Coupling;* John Ryan, Wilmington, Del.

Claim.—"The surfaces of the hook and inside and outside of the buffer mouth, so arranged and constructed, that the hook presented in a vertical position, shall be caused to rotate to a horizontal position on entering, and resume its vertical position when driven in to hold the cars, and by a deviation of the cars to one side, caused to rotate again to a horizontal position, so as to uncouple by said deviation, and the leverage between the hook and head, the buffer mouth not allowing the hook to pass either way, except when horizontal."

122. For an *Improvement in Guides for Sewing Machines;* Frederick R. Robinson, Worcester, Massachusetts.

"The nature of the invention consists in the manufacture of boots and shoes, as well as various garments. It often becomes desirable or necessary when two pieces of cloth or material are sewed together, to run one or more line of stitching parallel to their seam or line of junction, and often very near thereto. It is the purpose of my machinery to effect this."

Claim.—"The combination of the seam gauge or guide with a sewing machine."

123. For an *Improvement in Cross-Head Attachment for Working Steam Engine Valves;* John B. Stott and Alexander Ferguson, Troy, New York.

Claim.—"The method of operating the valves of steam cylinders by a series of trips attached to and sliding with the cross-head of the piston, which trips operate in succession upon the arms of a vibrating shaft connected with the valve rod through cams fixed near the ends of the arms, the trips themselves consisting of a variable and adjustable one to move the valves, so as to cut off the steam before the end of the piston's stroke, leaving the eduction passage slightly open a second, to shift the valves a little further at the end of the stroke, so as to take steam for the new stroke and open wider the eduction passage, and a third to shift the valves, so as to open the induction and eduction passages to their fullest extent. The two first movements of the valve being made by the movement of the cross-head in one direction, and the other by the reverse movement thereof, the last operation being produced by the joint action of the spring cam on the arm and the recessed trip."

124. For an *Improved Machine for Sawing Down Trees;* Matthew Ludwig, Boston, Massachusetts.

Claim.—"Attaching the connecting rod to a sleeve, which works upon a bar, H, attached to the framing; the bar I, of the saw being attached to the sleeve, and the bar, H, having an arm attached to it, which arm has a lever attached, one end of which is provided with a friction roller, which bears against the bar, I, and keeps the saw to its work, in consequence of the cord and weight attached to the opposite end. The bar, H, being arranged, so that it may be turned and allow the saw to cut in a vertical or horizontal position."

125. For an *Improvement in Constructing Iron Ships;* Otis Tufts, Boston, Mass.

Claim.—"Constructing the hull, decks, and bulkheads of ships with a double shell of iron, inter-fastened for greatest strength with binders."

126. For an *Improvement in Metallic Blinds for Doors and Windows;* William E. Worthen, City of New York.

Claim.—"1st, A tubular metallic window blind slat containing in the cavity thereof a non-conductor of heat. 2d, Pivots and grooves, or their equivalents, in combination with metallic slats, capable of vibration and of rising and falling, by which a firm, secure shutter is constituted, while the ordinary uses of inside venetian blinds are still retained. 3d, A locking bar in combination with slats, capable of vibration and motion, in a plane vertical, or nearly so. 4th, Arranging arms to which are attached vibrating chains, and also vibrating chains in a recess separated from the slats proper. And, lastly, a supporting chain in combination with slots capable of vibration and motion."

127. For an *Improved Water Wheel;* William M. Wheeler, Upton, Massachusetts.

Claim.—"1st, Closing the buckets by means of the band or chain in connexion with the arms and springs. 2d, The guard with its slides, operating in the manner and for the purposes described, or any other substantially the same."

128. For an *Improvement in Churns;* Moses D. Wells, Morgantown, Virginia.

Claim.—"The construction of the dasher with an inclined continuous channel for producing the upward flow of a continuous hollow column of cream at each down stroke of the dasher, and thus favoring atmospheric action."

129. For an *Improved Excavating Machine;* Edwin Williams, Covington, Ky.

Claim.—"An excavating shovel or scoop provided with one or more cables, or their equivalents, and having its rear portion or handle hinged to one extremity of a boom which has longitudinal and vibratory motion about an elevated pinion, or its equivalent, the unattached extremity of said boom being made to counterbalance the scoop in the acts of dumping, &c."

130. For an *Improvement in Gas Burning Gridirons;* Edwin D. Willard, Washington, D. C.

"The nature of the invention consists in having two lines of escape holes for the gas, at a distance from the centre upper line of each bar, of one-eighth the circumference of the bar, instead of one row of holes on the centre upper line, this covered with a corrugated plate moving upon ways or slides, and operated by rack and pinion, so as to make the flame act upon each part of the corrugated plate."

Claim.—"The gas burning tubes in combination with a corrugated plate acted upon by rack and pinion, and moving upon slides."

131. For an *Improvement in Looms;* Edward Wood, Philadelphia, Pennsylvania.

"The nature of the invention consists in the construction, arrangement, and operation of the picker stopper of those booms which require a moving shuttle box, so that it shall always be held in a firm unyielding or non-elastic condition when receiving the blow of the shuttle on the arrival of the latter within the said box, and, also, so that it shall be compelled to move out from the point or tip of the said shuttle, so as entirely to relieve the same from all contact therewith, before the shuttle box commences to move, without the use of a rock shaft, cams, springs, or other like objectionable and complicated devices for the purpose."

Claim.—"The rigid or non-elastic picker stopper constructed and arranged upon the lay, and operated by means of the rigid link or curved rod, or its equivalent, when in connexion with said stopper and the frame of the loom."

132. For an *Improvement in Harvesters;* David Watson, Petersburgh, Virginia.

"The nature of the invention consists in so arranging the reciprocating cutters, that the standing grain is gathered by the fingers into acute angled spaces and severed by the receding motion of the cutters, or whilst they are moving towards the acute angle, whereby the straw is held more firmly to the cut than when the cutter is operated at right angles with the travel of the machine, and the cutters being arranged diagonally to the line of motion makes them at least double the length they would be for clearing the same breadth of land if at right angles thereto, so that each finger gathers but half the quantity of straw, which is consequently severed with greater ease and certainty."

Claim.—"The arrangement of a reciprocating cutter or cutters diagonally to the line of motion of the machine."

133. For an *Improvement in Lanterns;* Charles Waters, Brooklyn, New York.

"The nature of the invention consists in the peculiar manner of securing the glass shade in the lantern, and also of securing the lamp within the lantern."

Claim.—"The application of the spring catch and lips."

134. For a *Turbine Water-Wheel;* Heny Van De Water, Troy, New York.

Claim.—"1st, The employment of the guide or concave conical projection at the lower part of the casing in combination with the cylindrical gate. 2d, The chutes or guides placed above the wheel in combination with the slides which form a gate by which the water is admitted in proper quantity upon the wheel and tangentially thereto. 3d, Surrounding the wheel with an annular chamber or recess, in combination with the buckets of the wheel, when said buckets are formed with smaller spaces between their lower ends than their upper ends, for the purpose of causing the water to act upwards against the lower surfaces of the buckets, and thereby relieve the step of the shaft of the weight of the wheel and said shaft."

135. For a *Self-Regulating Wind-Mill;* Joseph Dickinson and Oliver White, Richmond, Illinois.

Claim.—"Applying to a wind-mill or motor a governor or regulator, which shall change the angle of the vanes with the plane of the periphery of the wheel, thus regulating the force of the wind upon them by the force of the wind or motive power alone by means of the face plate, spring, rods, and cranks, or their equivalents."

136. For an *Improvement in Knitting Machines;* John Pepper, Assignor to the "Franklin Mills," Franklin, New Hampshire.

Claim.—"Making the plain work, needle bar, or frame, stationary, its needles movable thereon and to operate in connexion with sinkers, (or their equivalents,) and applying thereto a movable or sliding cam bar, (or its equivalent) so as to operate the plain work

needles in succession, the advantage of such, not only being that no forward movements of the sinkers are necessary in order to bring the loops of the yarn into the hooks of the needles, but that such simplifies the machine, and thereby correspondingly diminishes the cost of its construction. And, also, in combination with the hooked sinkers and ribbed needles, the series of cast off sinkers, or those formed without hooks, the same being arranged in the sinker bar, and not only so as to admit the rib needles to work between the hooked sinkers, but so as to render the machine capable of performing either plain or ribbed work. Also, making the rib needle take the place of the front or hook of the sinker in forming the loop for the rib stitch."

137. For an *Improvement in Machinery for Preparing Wool for Combing;* Albert Reinhardt, City of New York, Assignor to N. Schlumberger & Co., Guebeviller, France.

Claim.—"The combination of the feeding, working, and drawing off apparatus, the feeding and drawing off apparatus being so combined, as to be alternately brought into action with the working drum, and brought to a state of rest when not in working contact with the drum."

138. For an *Improvement in Devices for Sealing Preserve Cans;* W. H. Elliot, Plattsburgh, New York.

"The nature of the invention consists in removing water or other liquid from preserve bottles, for the purpose of producing a more perfect vacuum than can be obtained by other means, said liquid being placed in such connexion with a vacuum in the pump, that it will fall by its own weight from the bottle into said vacuum, leaving a perfect vacuum in the bottle, and in the combination of certain devices, which, with or without a liquid in the bottle or vessel to be exhausted, may be used to exhaust the same, and of a device by which the liquid, after it leaves the bottle, is made to assist in sealing the bottle. Said device consisting of a plug or seal, and the tube and plunger for carrying said seal to its place."

Claim.—"The use of the plug, or its equivalent, in sealing exhausted vessels, with or without the tube in connexion with the plunger, or its equivalent."

139. For an *Improvement in Fire Arms;* John A. Reynolds, Elmira, New York.

Claim.—"Constructing fire arms with a hollow cylinder, A, containing chambers in connexion with barrels. Also, loading the chambers by foot pedal, straps, H H, levers, K K, operating the plungers in combination with the simultaneous capping of the nipples by lever N, straps 5 and 6, cross-bar, O, and plungers thereon for removing caps from cylinder P, and placing them on the nipples. Also, drawing the hammer by lever R, and bar S, furnished with spring and catch thereon, or its equivalent, in connexion with the angular liberating projection on spring and the liberating post. Also, drawing the hammer back in combination with the simultaneous swabbing of the discharged chambers. Likewise, the swabbing for containing the swabs furnished with sponge, or its equivalent."

140. For an *Improvement in Fire Arms;* John A. Reynolds, Elmira, New York.

Claim—"The elevation of the manifold fire arm by the screw nut on swiveled arms in connexion with pulleys and chain, or their equivalents. Also, the adaptation of the shields to the manifold fire arm, or similar machine."

141. For an *Improved Apparatus for Cocking Repeating Fire Arms;* John A. Reynolds, Elmira, New York.

Claim.—"The application of a refrigerator to the barrel or tubes of fire arms for the purpose of keeping said tubes from undue heating."

142. For an *Improvement in Tile Machines;* Gottleib Graessle, Rossville, Ohio; dated June 12, 1855.

Claim.—"The combination of the two endless chains, corresponding moulds, and pressure rollers."

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143. For an *Improvement in Machines for Cutting Sheet Metal;* Cephas Applebee, Lyndon, Vermont.

Claim.—"The combination of the movable bar, its clamps, and one or two sets of rotary cutters, with the index limb or arc, the movable radial supporting arms and their

two end shears, the whole being applied together and used to operate on a piece of metal or other material, and reduce it to the shape of an annular section, suitable for being bent into the shape of a conic frustum."

144. For an *Improvement in Machines for Cutting Boot and Shoe Uppers, Soles, &c., from Sheets of India Rubber;* John Arthur and Evan Arthur, New Brunswick, New Jersey.

Claim.—"1st, The cutting or separation of india rubber by placing it on a wet cloth or other suitable moistened surface, and submitting it to the pressure of a heated die having an edge of the form of the article to be cut. 2d, The combination of one or more reciprocating die frames, each carrying a set of dies with a stove, and with carrying and pressing apparatus to carry the sheet or piece of rubber, so that the dies by their reciprocating movement, may be carried into the stove to be heated and then returned to cut or stamp out the pattern or article from the piece. 3d, The method of raising the die frames to carry the dies on their return movement towards the stove, far enough above the roller for other die frames to pass below them, by extending the ends of the side pieces of the said frames some distance beyond the pivots which connect them with the chain, and providing pins for the ends of the die frames to strike against to throw up the opposite ends carrying the dies. 4th, The swinging frame with its fingers to conduct the points or ends of the patterns as soon as they are cut or separated between the roller upon which the cutting is performed, and another roller, by which they are at once prevented curling it, and are conveyed along towards where they are delivered from the machine.

145. For an *Improved Whiffle Tree;* Archibald Bailey, Blue Rock, Ohio, and Danl. L. Allard, Rokebay, Ohio.

Claim.—"In combination with the compound levers, the pivoted cam-shaped catches or hooks for holding or instantly releasing the cock-eyes of the traces, by which arrangement we secure the parts against imperfect action and are enabled to embed all the parts within the single-tree."

146. For an *Improvement in Feeding Water to Steam Pipes by Auxiliary Engines;* William Ball, Chicopee, Massachusetts.

Claim.—"Causing the pipe which conveys the steam from the boiler to the feed engine to enter the boiler at the exact level at which the water is required to stand."

147. For a *Double Reciprocating Split Piston Rod for Pumps, &c.;* John A. Burnap, Albany, New York.

Claim.—"The double reciprocating split rod gear, when arranged and operating longitudinally side by side with the inner faces of the rods bearing against and acting as long moving guides and supports to each other, to strengthen them and prevent lateral shake or play while their exterior is bound and tightened by one packing box, and the two rods or split portions with their respective valves or pistons are free to move separately or in opposite directions to each other, for the admission, discharge, or cutting off of the gas or fluid or for operating by the gas or fluid."

148. For an *Improved Window Blind;* Frank Chase, South Sutton, New Hampshire.

Claim.—"Constructing blinds by nailing or securing oblique or diagonal slats to both sides of a frame, the slats on one side of the frame being opposite to or covering the spaces between the slats on the opposite side."

149. For a *Machine for Turning Cylinders of Wood, &c.;* Matthew F. Connet, Plainfield, New Jersey.

Claim.—"So combining a swing frame, which carries the block to be cut, with a cutter or cutters revolving around a fixed centre, as that the block may be swung up to the cutters and first cut to the required depth or gauge without revolving, and then be revolved slowly on its centres against the action of the cutters to complete the turning at a single revolution of the block."

150. For an *Improved Paging Machine;* F. G. Degener, City of New York.

Claim.—"1st, The guide flanch or guide flanches, in combination with the pawls, stop finger or stop fingers, and ratchet. 2d, The cam or cam-shaped piece, in combination with a rotating reciprocating or vibrating arm and pawls, for the purpose of operating movable series of fingers, so as to produce different combinations, and giving to

them, by means of the cam, the requisite motion and time of rest when the machine is in operation. 3d, The combination of the inking table, being surrounded by the figures or characters to be printed. 4th, The combination of the inking table and spring. 5th, The combination of the spring hinge or joint with the roller arm. 6th, The mode of adjustment by raising or lowering the machine."

151. For a *Hydro-Pneumatic Machine for Exhausting and Sealing Vessels;* W. H. Elliot, Plattsburgh, New York.

Claim.—"The yielding lining of mouth, the chamber, with its elastic movable portion, and the lever, with or without the liquid used for expelling the air from the chamber, or their equivalent, when used in combination."

152. For an *Improvement in Machines for Sizing Hat Bodies;* Phineas Emmons, City of New York.

Claim.—"The water box, having the partition or graduating pressure board therein, in combination with the vertical disk wheel having a ribbed or corrugated face and self-adjusting weighted levers."

153. For a *Sawing Machine;* Benjamin Fulgham, Richmond, Indiana.

Claim.—"1st, Placing the reciprocating saw frame, G, provided with a vertical circular saw and a horizontal circular saw within a frame, G, and placing or centering the log to be sawed between shafts. The frame, G, being lowered at every stroke or vibration of the saw frame G, and the log turning simultaneously therewith, a gradually increasing distance at every stroke or vibration of the saw frame for the purpose of cutting "the stuff" an equal thickness direct from the log and in a spiral manner. 2d, Operating the log and frame G by means of the bar attached to the wheel, said bar being attached to the arm, which is secured to the lever, when said lever is passed through a slotted plate attached to the frame G, for the purpose of gradually increasing the feed motion of the log, and causing the stuff to be sawed of an equal thickness."

154. For an *Improvement in Bridle Reins;* Kingston Goddard, Philadelphia, Pa.

Claim.—"The arrangement of the reins by making the snaffle rein tubular in part to receive the curb rein."

155. For a *Machine for Boring and Mortising Hubs;* Chauncy H. Guard, Brownsville, New York, Assignor to John A. Scroggs and Chauncy H. Guard, New Castle, Pennsylvania.

Claim.—"The arrangement of the levers and the segments with the right and left screws on the periphery of the bit holders, in such a manner, that a proper position of the said levers and segments will cause the rotary motion of the said holders to move them longitudinally either inwards or outwards, and which position may be instantly reversed at the pleasure of the person operating the machine. Also, arranging the rack bars and the upper and lower chisels in such a manner, that the said chisels can be made to simultaneously strike upon opposite sides of the hub placed between them. Also, arranging the rack bars, the supporting and guiding bars, and the regulating screw in such a manner, that the chisels may be made to act in corresponding vertical or oblique directions in forming mortises."

156. For an *Improved Hand Stamp;* Joseph Harris, Jr., and Elbridge Harris, Boston, Massachusetts.

Claim.—"The peculiar oscillating motion of the stamp, also, the same in combination with the inking roll and its adjusters."

157. For an *Improvement in Machinery for Making Rope;* John Harris, North Hoosick, New York.

Claim.—"1st, The method of driving the flyers by means of the cone pulleys and the band or ring, either the said band or ring or the bearings of the flyers having springs applied to keep the pulleys and band properly in contact with each other at all times, and the band or ring being movable in the direction of the axes of the flyers to come in contact with a larger or smaller part of the cone pulleys, and thus vary the speed of the flyers and the twist of the strands while the machine is in operation. 2d, Making the cans of polygonal form to fit snugly between the pillars or side pieces of the flyers, in combination with the springing collar applied to fit over the top of the can, whereby the cans are enabled to be quickly taken from the flyers and replaced."

158. For *Improvements in Machines for Cutting Files;* Horace Hotchkiss, Waterbury, Connecticut.

Claim.—"Supporting the file blank upon a compound carriage having both a rotary and a lateral adjustment horizontally, while the cutter is adjusted only in a plane passing through the apex of the cutter and bisecting its edge, and is at the same time perpendicular to the edge of the cutter and to the plane of the file carriage. Also, placing the cutter in line with the hammer and in the same adjustable frame therewith, so that when the position of the cutter is changed by an adjustment of this frame, the hammer shall also be adjusted by the same operation to conform to the position of the cutters."

159. For an *Improvement in Carriages;* Moses G. Hubbard, City of New York.

Claim.—"The cross bar for attaching the forward axle to the other parts of the running gear and bar for the king bolt."

160. For an *Improvement in Stalls for Horses, &c.*, John Jenne, Bethany, N. Y.

Claim.—"1st, The swinging partitions. 2d, The doors in combination with the planks. 3d, The sleeves in combination with the chains, to prevent the animal from injuring himself by rubbing against the chains."

161. For an *Improvement in Machines for Making Railway Chairs;* James Kelsen, Canton, Mass., Assignor to self and George Banks, East Boston, Massachusetts.

Claim.—"Combining with each of the punches and its driver, a lifter and mechanism for operating such lifter, such punch being applied to the bending die and supported on a spring. (The chairs of wrought metal.)"

162. For an *Improvement in Parlor Stoves;* Francis Kenney, Springfield, Mass.

Claim.—"The arrangement of the pipes, M, tubes, chamber, and pipe, I, when provided with the dampers."

163. For an *Improvement in Making Gutta Percha Boats;* Edwin B. Larchar, Baltimore, Maryland.

Claim.—"The method of making a safety boat or other vessel of gutta percha mixed with glue, so that the air chambers or other parts, if separately formed, may, together with the boat body, be united and completed at one pressure, or, that if the braces, knees, thwarts, supporters, or other accessions to the boat proper are solid, the whole with the inner and outer forms may all be made or completed together at one time and at one pressure. (One ounce of glue to every pound of gutta percha.)"

164. For an *Improvement in Processes for Smelting Iron;* Samuel Macferran, Philadelphia, Pennsylvania.

Claim.—"The use of gas carbon as a fuel in the process of smelting iron."

165. For an *Improvement in Processes for Hulling Cotton Seed;* Daniel W. Messer, Boston, Massachusetts.

Claim.—"Separating the kernel from its shell and fibre previous to expressing the oil by the method described, or by any other method substantially equivalent thereto, the seed being macerated to soften the shell, and then submitted to pressure for the purpose of pressing out the kernel."

166. For an *Improvement in Apparatus for Administering Pulverulent Medicines;* Jonas Moore and D. P. Adams, Marietta, Ohio.

"The nature of the invention consists in facilitating the administration of nitrate of silver, by grinding it to fine dust to be inhaled."

Claim.—"The combination of the machinery for turning the emery wheel with a discharge pipe, for the purpose of administering pulverulent substances in cases of inflammation of the mouth and throat."

167. For a *Balance Water Gate;* E. N. Moore, Lenox, Pennsylvania, and Isaac B. Hanyan, Chester, New York.

Claim.—"Constructing a water gate by having two disks or plates of proper form attached to opposite ends of a shaft, which passes transversely through a box, said disks bearing against the projections on the sides of the box and over openings in the sides of said box."

168. For a *Water Metre;* Henry R. Worthington, Brooklyn, New York.

Claim.—"The employment of two cylinders, which may be distinguished as cylinders Nos. 1 and 2, with pistons working in the same, so arranged and combined with regard to each other, as that the motion in cylinder, No. 1, shall actuate the supply and delivery valve of cylinder, No. 2, while, in like manner, the motion of the piston in cylinder, No. 2, actuates the supply and delivery valve of cylinder, No. 1, thus producing a positive and direct motion."

169. For an *Improvement in Hinges;* Joseph Plegar, Birmingham, Pennsylvania.

Claim.—"Making a bolt on the pin part of the hinge and a cup or socket in the upper section of the hinge to receive the bolt."

170. For an *Improvement in Shuttle Guides for Looms;* Horace T. Robbins, Lowell, Massachusetts.

Claim.—"An improvement on my former invention, which was patented September, 14th, 1852, which consists in furnishing the shuttle guides with pulleys, or their equivalents."

171. For an *Improvement in Wagons;* Joseph Thornton Russell, Tyler County, Va.

Claim.—"The construction of the "standard receiver," and the application thereof to wagon bolsters."

172. For *Hydrodynamic Friction Joints;* Thure Emanuel Sandgren, Wilmington, Del.

Claim.—"The forming of a hydraulic bearing for a rotary shaft by means of the water ducts passing through the cylinder or case, in which the shaft rotates, for the purpose of supplying water as a lubricator to the rubbing surfaces."

173. For an *Improvement in Preparing Potash and Soda;* George Thompson, East Tarentum, Pennsylvania.

Claim.—"The use of a tray and sector, constructed for the purpose of dividing caustic soda or potash into parcels of convenient size and shape and of uniform weight. (The potash or soda being in a melted state.)"

174. For an *Improvement in Seed Planters;* Pierpoint Seymour, East Bloomfield, New York.

"The nature of the invention consists in the mode of regulating the delivery of the seed from the seed box, with the apparatus therefor, and the double or additional seed box for sowing broad-cast while drilling."

Claim.—"1st, The combination of the movable side of the seed box with angular hangings, spring, and inclined planes or wedges, or their equivalent, for the purpose of opening and closing said box and to regulate the quantity of seed or substance to be delivered. 2d, The side plate to prevent the seed from clogging. 3d, The combination of the angular levers, having their fulcrum or inclined standards, or its equivalent, with the rods linking them to the drill tubes."

175. For an *Improvement in Washers for Axles;* Alfred E. Smith, Bronxville, N. Y.

Claim.—"Inserting blocks of metal, or other equivalent hard substance, in packing washers made of leather, or other equivalent flexible and yielding substance."

176. For an *Improvement in Oscillating Valves and Gearing for Pumping Engines;* Charles A. Wilson, Newport, Kentucky.

Claim.—"1st, Balancing oscillating valves under all lateral pressures on the exterior arising from steam or air, and regulating the exhaust ports. 2d, Balancing the end pressure in the interior caused by steam in conical valves by the annular recess, *b b*, equal and opposite to *a a*, and the balance piston or steam valve on a beveled seat. 3d, Supporting the tripping apparatus consisting of the angle, trip lever, toggle joint, and upper lever, or their equivalents, so as to relieve the valve from all weight and consequent friction and wear. 4th, Using the safety arm to insure and regulate the cut-off, and the cam jogs of depth regulated by cutting set screws, or other equivalent device for operating the same. 5th, Using the independent rod attached to the piston of the steam cylinder for working the valve gear, whereby bringing the steam cylinder and pump close to each other, space is economized while power is gained."

177. For an *Improvement in Refrigerators;* William Mootry, City of New York.

Claim.—"1st, The application and employment of a vessel or chamber for contain-

ing both the ice and water together, serving the double purpose of a water cooler and frigorific body, in combination with the ordinary refrigerating box, chamber, or other insulated non-conducting cooling apparatus. 2d, The mode of ventilating by compelling the outer atmospheric air before entering the interior to come into mediate contact with the ice or other frigorific body. 3d, The mode of ventilating in combination with the cooler and refrigerating chambers."

178. For *Improvements in Grain and Grass Harvesters;* Jesse Urmy, Wilmington, Delaware.

Claim.—"1st, In combination with the driving wheel placed inside the gearing, the angular tongue for preventing side draft and at the same time allowing the horses to walk on the side of the standing grass or grain. 2d, The use of the balanced dogs under the driver's feet for throwing the cutting apparatus in and out of gear. 3d, Making the parting and gathering board hinged and adjustable. 4th, Regulating the size of the sheaves by means of the several ranges of gearing within the driving wheel, in combination with the adjustable pinion."

179. For an *Improvement in the Union Platform Scales;* Augustus Sanborn, Assignor to E. & T. Fairbanks & Co., St Johnsbury, Vermont.

Claim.—"The manner in which the platform lever and the vertical suspension rod, *b*, of the pan and steelyard are connected and supported, the rod, *b*, being jointed at its lower end to an arm independent of the lever, and said lever connected to the rod, *b*, by means of a pendulous rod, *h*, and a pointed or knife edge bearing arranged near the upper part of the rod *b*, the same while securing a vertical movement to the rod *b*, (the only one which it should have) effecting the advantage of allowing the lateral vibrations of the lever to take place without disturbance of the steelyard or rod *b*."

180. For an *Improvement in Furnaces for Treating Zinc Ores;* Samuel T. Jones, City of New York.

Claim.—"The double use of the chimney by combining the said chimney governed by a damper or register with the furnace and collecting apparatus and interposed between the two, whereby, the iron contained in the ore can be worked after the zinc has been worked and collected."

181. For a *Machine for Feeding Paper to Printing Presses;* Andrew Campbell, Newark, New Jersey.

Claim.—"1st, The mode of operation, by which the pile or piles of sheets is or are moved up or down and kept in position as the sheets are taken from or laid on the pile, that the upper sheet of the pile may, at all times, be in the proper position to be acted upon by the mechanism which removes it, or which deposits it, which mode of operation consists in lifting or depressing the table or tables on which the pile is placed by the mechanism described, or the equivalent thereof, in combination with the gauge and holding bar, or any equivalent therefor, which rests on the top sheet to hold it down, and which, by its position on the pile and its connexion, governs and controls the movements of the lifting or depressing mechanism, the said mode of operation being employed to govern the position of the pile on the feeding and receiving tables, or either. 2d, The mode of operation for holding the upper sheet of the pile on the receiving table on which the sheets are in succession deposited, so that as the sheets are drawn over the pile in succession, the sheet previously deposited shall not be moved from the position in which it was deposited, the said mode of operation consisting in the use of a wing or plate which rests on the upper edge of the pile at that end of it over which the sheets move as they are drawn over the pile, and which then rises to permit the newly deposited sheet to fall, and again descends to hold it preparatory to the introduction of another sheet, the said wing or plate being operated in the manner substantially as described, or any equivalent therefor. And this, whether the said wing or plate be employed for the sole purpose of holding the upper sheet of the pile on the receiving table, or for this and for the purpose of gauging and controlling the mechanism which depresses the receiving table. 3d, Making pressure on the surface of the pile of sheets on the feeding table and within a short distance of the edge, which is to be lifted for the purpose of forcing the sheets at that end of the pile to open fan-like, that the separation may be more effectually made. And this, whether the required pressure be made by the rounded surface on the exhaust bar or by a separate bar having the like mode of operation. 4th, Making the surface of the exhaust bar concave, so that the upper sheet, which is to be removed from the pile, shall be drawn into the said concavity, and thereby draw its edge within the edge of the pile the more effectually to insure the separation. 5th, Placing the concave

surface of the exhaust bar, so that it shall overlap or extend beyond the edge of the pile, that the whole of that portion of the sheet which is to be acted upon by the exhaust may be within the concavity of the exhaust bar, thus causing the inward current to pass upwards under the projecting concave surface of the exhaust bar and across the edges of the pile to insure the separation of the edges of the sheets. 6th, Blowing in a current of air at one or both ends of the concavity of the exhaust bar, to insure the separation of the top sheet from the rest of the pile preparatory to removing it from the pile. 7th, The employment of the transferring or holding bar connected with the exhaust and blowing bellows, or equivalents therefor, in combination with the exhaust bar, by means of which, that end of the top sheet which has been separated from the pile, is transferred from the exhaust bar to, and held by the said transfer bar until it is taken by the gripers, or any equivalent therefor, that the exhaust bar may be removed preparatory to carrying off the top sheet. 8th, The method of thumbing the edge of the pile to insure the separation of the edges of the sheets where they are liable to adhere, by means of the rotating spring flippers, or any equivalents therefor. 9th, The mode of operation, by which the griping end of the jaws which gripe the sheet of paper, are made to maintain a fixed position relatively to the edge of the sheet held by the transferring and holding bar during the entire operation of griping the sheet, and during a portion of the operation of reversing the jaws by the continued motion of the endless chain or band with which the rear part of the jaws are connected. 10th, Removing the sheets in succession from the pile by griping one end of each sheet in succession with griping jaws after the end has been separated and lifted from the pile by other means, and rolling it off the pile by the motion of the griping jaws towards the other end of the pile, by which all tendency to disturb the sheets below is avoided. I do not claim broadly the fact of rolling off the sheet from one end of the pile towards the other, but limit my claim to the mode of operation specified, by which I attain this end in a practical and efficient manner. 11th, Making friction on both surfaces of the sheet when brought over the pile on the receiving table in combination with the gripers, so that the moment it is liberated by the jaws, the friction on both surfaces shall hold and leave it in place on the pile, whereby the accurate deposite of the successive sheets is made to depend solely on the period of opening the jaws. 12th, Making pressure on and packing the pile of sheets on the receiving table as each sheet in succession is deposited, by means of a perforated plate, the perforations in the plate giving free access to air, that the plate may be lifted without drawing up the sheets with it. I do not claim broadly making a pressure on the pile, except by means of a perforated plate extending over the entire pile to pack down the entire surface, the small perforations preventing the sheet from being lifted whilst they do not prevent the packing down of the pile. And, finally, the employment of pointed punches to punch holes in the sheets as they are piled on the receiving table, so that the pile may be transferred and moved without shifting the position of the sheets relatively to each other in the pile."

182. For an *Improvement in Candle Mould Apparatus;* Willis Humiston, Troy, New York.

Claim.—"Making the top of the piston, in which the tip of the candle rests, movable on the piston, so that it may remain in contact with the candle whilst the piston is slightly depressed or lowered to bring it up with a sudden blow to start the candles from the moulds. Also, in contradistinction from clamping the wicks or from a tip bar or supporter, the clamping of the candles themselves in the position in which they are forced from the moulds, and thus holding them until ready to be removed, by which means I retain greater facilities for pouring into or filling the moulds and avoid the danger of breaking the candles or their tips."

183. For an *Improved Printing Press;* Merwin Davis, City of New York.

Claim.—"1st, The oscillating bed, having a plane surface, and contradistinguished from a rotating or sliding bed by oscillating between two given points. Also, the construction and operation of the platen in combination with said bed. Also, the adaptation and combination of the well known fly for laying the sheets, the slide for the reception and the delivery of the paper, and the inking apparatus to the new construction and arrangement of the bed and platen."

184. For an *Improvement in Propellers;* Augustin Dubace, Brooklyn, New York.

"The nature of the invention consists in giving to each blade two motions, the vibratory motion in the plane of a vertical cross section of the vessel, and the reciprocating rotary motion on its axis, by jointing the arbor of the blade to the vessel with a ball and

socket joint, or its equivalent, in combination with an arm projecting from the said arbor above its ball and socket joint, the end of which arm is connected by a slipping and ball and socket joint, or the equivalent thereof, with a wheel or crank arm on the driving shaft, the arbor of the blade being kept in the plane of the vertical cross section by suitable guides, or their equivalent, whereby, as the driving shaft rotates, the end of the arm at its connexion with the slipping and ball and socket joint, is made to describe a circle, which imparts to the blade the lateral vibratory motion towards and from the vessel's side, as well as the reciprocating motion on its axis to reverse the direction of its obliquity, this latter motion being mainly imparted to the blade at the end of each lateral vibration by reason of the passage of the end of the arm at the upper and lower dead points of the crank-like motion."

Claim.—"Connecting the blades with the sides of the vessel by means of a ball and socket joint, or any equivalent therefor, in combination with an arm projecting from the arbor of the blade, the end of which arm is connected by a sliding and ball and socket joint, or any equivalent therefor, with a wheel or crank arm on the crank."

185. For an *Improvement in Cheese Presses;* George R. Comstock, Manheim, N. Y.

Claim.—"The roller in the lower portion of the pressing gate, and brought into action by the rising of said gate in the removal of the pressure."

186. For an *Improvement in Bottle Fastenings;* John Allender, New London, Conn.

Claim.—"The strap constructed with hinge and hook for holding in and releasing the corks or stopples of bottles, jugs, &c."

187. For an *Improvement in Wrought Iron Shafts;* James Montgomery, Baltimore, Maryland.

Claim.—"The construction of a hollow compound shaft by means of the bars and wedges arranged and welded together only at the journals or bearings, while the bars are separated by sufficient spaces at all other parts."

188. For an *Improvement in Starch Making,* Henry Colgate, Jersey City, N. J.

"Process: Dissolve one hundred pounds of refined sugar in sixty gallons of clear cold water, and mix it with the starch just after the starch is separated from the gluten in the cisterns, stirring the solution well together. One pound of sugar to every thirty pounds of starch."

Claim.—"The process of manufacturing starch, by adding to it in the process of making, a certain amount of sugar."

189. For an *Improvement in Calender Clocks;* John Williams, Hartford, Conn.

Claim.—"Completing the revolution of the wheel, B, at the end of the shorter months by means of sliding teeth, which are suitably attached to the said wheel, and severally or collectively, as required, brought into such positions, as to enable them to be acted upon by the teeth on the daily revolving wheel, A, by means of the "four year wheel," D, which is on the same arbors, but independent of the wheel B, the said wheel D acting upon the said sliding teeth by means of its forty-eight projecting and receding divisions, and by pins or teeth arranged upon it, and being for that purpose moved one forty-eighth part of a revolution independently of the wheel B for every revolution of the said wheel B."

190. For a *Machine for Dressing Lumber from the Log;* Albert Walcott, Detroit, Michigan.

"The nature of the invention consists in the planing, tonguing, and grooving, matching, or otherwise dressing in the solid timber before sawing, or in connexion with sawing after the logs have been sawed into cants or thick plank of the desired thickness to make the width of the desired dressed stuff, or, in other words, the dressing and the sawing at the same time, the dressing only preceding the sawing by the distance between the dressing machinery and the saw, as the cants or plank are moved forward past the dressing machinery first, and then the saw at one and the same time and on one and the same machine. The first process of the operation consists in sawing into cants or plank of the desired thickness to make the required width of dressed stuff. The second process is —place one of such cants or plank on some kind of a carriage which may be made to traverse in a direct line, without variation, as near as possible, by machinery, forwards and backwards, something more than the length of the stuff to be manufactured, in a similar manner to the common siding mill, for sawing siding, now in use."

Claim.—"The particular arrangement and combination of mechanism for manufacturing and dressing out lumber from the log, or plank, (as the case may be,) by successive operations, and in any manner substantially the same, not confining myself, however, to any particular arrangement of mere mechanical details or devices to effect the desired result, that is, a piece of lumber finished or partially so (as the case may be) for building and other purposes."

191. For *Improvements in Machinery for Dressing and Carving Stone;* Elias A. Swan, Brooklyn, N. Y., and De Witt C. Smiley, City of New York.

Claim.—"1st, The method of dressing, carving, or cutting stone, or similar rigid and unyielding substances, by the use of a rotating cutter, whose cutting edge is spiral or at an incline with the axis of said rotating cutter; thereby the cutting edge always operates obliquely on the material under treatment, and effectually prevents any blow on the stone that would produce a vibration of the machine or break the cutter or stone. 2d, The method of fitting a horizontal or inclined rotating cutter, so that it can be kept radially with any curved mould or cut it may be forming, viz: by the use of the yoke and parts attached."

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192. For an *Improvement in Washing Machines;* John H. Atwater, Kalamazoo, Mich.

Claim.—"The arrangement of the washing frame and the endless platform of slats, together with the respective parts combined therewith, in such a manner, that the same first mover will, at the option of the operator, simultaneously impart a reciprocating movement to the washing frame and a forward or a rearward movement to the said platform, or operate the said washing frame."

193. For an *Improved Method of Feeding Planks to Planing Machines;* Nelson Barlow, Newark, New Jersey.

Claim.—"The self-adjusting frame connected by axles, or any equivalent means, to the main frame, when combined with the cylinder and fixed rollers."

194. For a *Fan-Blower;* Simon Barnhart, Chilicothe, Ohio.

"The nature of the invention consists in making each of the blades with a flanch or lip on one of its sides, said flanch or lip being straight or at right angles with the blade from the tip to the centre of the same, and therefrom is bent down and made to extend obliquely outward, in such a manner, that a small spiral wing is formed on each blade, which extends outside the case through the inlet air passage of the same, and as the fan revolves, collects and forces an additional quantity of air into the case."

Claim.—"Providing each of the blades of the fan with a lip or flanch."

195. For an *Improvement in Washing Machines;* Oliver D. Barrett, Fulton, N. Y.

Claim.—"Providing a pail with a foot piece and treadle, in combination with the connecting rod, lever, and sectors operating the rollers, by which combination the rollers are thrown apart by their own weight, and brought together by means of the foot and the action of the mop in being pulled out between them."

196. For an *Improvement in Air Engines;* John Ericsson, City of New York.

"The application of the caloric in this engine is identical with that of the air engine, for which I obtained patents in England and other countries in the year 1833, descriptions and drawings of which have been published in several works, among which may be mentioned a work called "Dictionary of the Arts of Life and Civilization," by Sir Richard Phillips, published in London, 1833. This work contains a correct delineation and description of my said air engine."

Claim.—"The method of supplying fresh air to the engine, compressing and transferring to the regenerator and heater, or either, by the action of the supply and working pistons within the one cylinder, whereby the air is admitted under atmospheric pressure as the supply piston is moving from the working piston, as the previous charge of heated air is exhausting, so that the said supply piston moves in equilibria, or nearly so, and by which, also, the supply air is finally compressed and then transferred to the regenerator and heater, or either, as the supply piston moves between the supply air and heated air during the period of the nearly stationary position of the working piston. Also, in combination with the double piston movement of each cylinder, the method of connecting

the working pistons of two single acting engines, to constitute a double acting engine, by means of two sets of vibrating arms attached to each other and vibrating on a common centre, connected with the two working pistons and with the two cranks on opposite sides of the crank shaft, the two sets of arms acting on the principle of the bent lever, and the crank shaft being so located relatively to the cylinders and the centres of vibration of the arms, that the working piston shall be at the end of its inward stroke, at the time the crank is passing the dead point farthest from the point of connexion of the connecting rod with the vibrating arm, by which the power of that working piston, which is being impelled by the heated air, is applied to the best advantage to operate the other working piston during its return stroke, and by which, also, the working piston remains nearly at rest during the time the supply piston is making that part of its outward stroke, during which the partially compressed air is finally and fully compressed and transferred to the regenerator and heater, or either."

197. For an *Improved Machine for Ruling and Paging Paper;* John A. Elder, Westbrook, Me., and John Richardson, Portland, Maine.

Claim.—"1st, The arrangement of machinery for the ruling, printing, and paging paper for the manufacture of blank books, or other like purposes, when the ruling printing, and paging is done before the paper is removed from the car or table where it is ruled. 2d, Also, the combination of a car or table and ratchet bar with its type rods, or their equivalents. 3d, Also, the pliers or nippers for the purpose of removing the paper from the car or table."

198. For an *Improvement in Machinery for Sizing and Dressing Warps;* John A. Elder, Westbrook, Maine, and Ephraim Wood, Winthrop, Maine.

Claim.—"The regulation of the speed of the yarn beams and rollers of the dressing frame by the tension of the warps, namely, by the combination of the vibrating roller, N, with the rollers L and I, rod, and the hook, or the equivalents thereof, and these in combination with the ratchet, lever, friction pulley, and weight, or their equvialents."

199. For a *Cross-Cut Sawing Machine;* Frederick Field, Toledo, Ohio.

Claim.—"The arrangement of the two circular saws hung in a vibrating frame, in combination with the mode of throwing the feed motion in and out of gear."

200. For an *Improvement in Vault Covers;* James Harrison, Jr., Milwaukie, Wis.

Claim.—"Attaching the cover to the upper part of the opening or passage of the vault by means of the jointing arms or rods, arranged as shown, or in an equivalent way."

201. For an *Improvement in Sewing Machines;* James Harrison, Jr., Milwaukie, Wis.

Claim.—"1st, Feeding the material to be sewed by means of a feed plate, which is guided in the direction of any curved circuitous or irregular line of sewing by means of grooves, or their equivalent, on its back side, of a form corresponding to the said line, receiving or working in contact with fixed pins, or other equivalent fixed guides, whereby motion is only allowed to the said feed plate in such direction as to make the material desirable in passing the needle, the intended line, the said feed plate receiving motion by any mechanical device suitable for the purpose. 2d, Combining the guide pins, or their equivalents, with the shoe which confines the feed plate, and produce the necessary pressure of the plate on the material."

202. For a *Machine for Sawing Ratan;* Liveras Hill, Charlestown, Massachusetts.

Claim.—"The arrangement of the rectilinear moving carriage, the adjustable holding bearer, the groove pressure roller, and the saw, whereby, when a stick of ratan is clamped to the adjustable bearer and the carriage is moved forward, so as to carry the said stick endwise against the saw while the latter is in revolution, such stick shall be sawed in a diagonal direction."

203. For an *Improvement in Machines for compressing Puddlers' Balls and other Masses of Iron;* Solon S. Jackman, Lock Haven, Pennsylvania.

Claim.—"The compressing puddlers' balls or similar substances by means of circular compressers, so arranged, that their peripheries shall have different degrees of speed, and their surfaces in contact with the mass to be operated on shall cause its rotation upon its own axis, and by compression between them, reduce the metal into a bloom."

204. For an *Improvement in Washing Machines;* Josee Johnson, Washington, D. C.

Claim.—"The arrangement and combination of disk, pestles, and spiral springs, or their equivalents, which form the pounder."

205. For a *Circular-Saw Mandrel;* Fielding H. Keeney, Newport, Kentucky.

"I make a shaft in the ordinary way, with bearings in any of the known ways. Then, instead of using a tight collar for the saw to rest against, I make a collar or collars with a hole larger one way than the other, with a pin or pivot through the collar and shaft, so that it may move back in an oblique direction on the shaft by screwing up or unscrewing the set screws, which screw in a stationary collar on the shaft, so that the set screws may set at right angles with the pin in the vibrating collars. The set screws also rest against a collar or washer, so that when screwed up again, the saw may hold it tight and firm between the collars at right angles with the shaft, or at any angle proper, so that as the shaft revolves, each part of the saw may cut its each part of the kerf or groove, thereby cutting it at any breadth (you may see proper to set it) at one cut or each revolution of the saw."

Claim.—"The mode of making a mandrel (as above described), not confining to exact size or shape, but to the principle of the machine, or any other equivalent device."

206. For an *Improvement in Distilling Coal with Hydrogen Gas;* Stephen Meredith, Meadville, Pennsylvania.

Claim.—"The production of naphtha, benzole, and other hydro-carbon liquids by the distillation of cannel or other bituminous coal, in an atmosphere of heated hydrogen gas, or in a retort to which a stream of heated hodrogen gas is admitted during the distilling process."

207. For an *Improvement in Cut-Off Valves for Steam Engines;* Frederick Perry, Newark, New Jersey.

"The nature of the invention consists in substituting steam pressure for holding the cut-off valves to their seats on top of the main valve, instead of using springs as heretofore."

Claim.—"The combination of the channels and hales with the cut-off valves and exhaust recess, or their equivalents, for the purposes set forth, or any other purpose for which they are suitable, merely modifying the parts to suit circumstances, when the principles involved are the same."

208. For an *Improvement in Artificial Legs;* Wm. H. Rhodes, M. D., Berlin, N. Y.

Claim.—"1st, The knee joint and ankle joint. 2d, Also, the standard and brace with their hinge joint connexion to foot plate, coiled spring, with rollers to hold the same, which retains the brace and standard in position when walking. The principles and improvements when united forming the apparatus."

209. For an *Improvement in Ventilating Hats;* William Sellers, City of New York.

Claim.—"1st, Making the hat or other similar head covering to open at its side or sides, by dividing the body of the hat and connecting or arranging the separated portions or sections of the body, so that the one portion of the body may be adjusted to form an open or close connexion with the other portion of the body. 2d, Providing the divided body at the junction of the two sections with a gimp guiding strip, or reticulated telescopic lining or casing, arranged for operation in connexion with the movable section of the body, whereby an ornamental and unbroken appearance is given to the hat all round when the body of it is open for ventilation."

210. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

"The nature of the invention consists in combining with the vibrating feed plate and spring or pressure pad a lifter below the cloth, which, at the appropriate time, is moved up to lift the cloth from the feed plate and against the downward pressure of the pad, that the feed plate may make its back motion without carrying back the cloth with it, the said lifter being then depressed to permit the cloth to descend on to the feed plate preparatory to the feed motion."

Claim—"The combination of the lifter with the vibrating feed plate and pressure pad."

211. For an *Improvement in Excluding Dust from Railway Cars;* Elam C. Salisbury, City of New York.

Claim.—"The method of preventing the dust, which is agitated and thrown upon the track by the passage of a train, from rising up and entering the doors, windows, and other apertures of cars, by inclosing the sides of the train from the bottom of the cars to within a short distance of the track, and closing up the spaces between the platforms of the several cars."

212. For an *Improvement in Water Gauges for Steam Boilers;* Paul Stillman, City of New York.

Claim.—"The construction and arrangement of glass water gauges, with the cocks having the axes of their chambers and keys in line with that of the glass tube, and the chambers having double water ways, and the movable guard rods supported by lugs on the chambers."

213. For an *Improvement in Musical Reed Instruments;* George S. Shepard, Canaan, New Hampshire.

Claim.—"The combination of the auxiliary sounding chamber and the swell chamber with the valve chamber."

214. For an *Improved Bucket for Water-Wheel;* C. C. Taylor, Dalafield, Wis.

"The nature of the invention has reference to the class of wheels known as percussion reaction wheel, and consists in constructing the bucket of a double inclined plane for bottom, and widening from top to outlet, so as to make the outer side of the bucket a conical surface, the upper inclined plane being perpendicular to the bottom of the water issue for receiving the percussion of the water under the most favorable circumstance."

Claim.—"Swelling the outer portion of the bucket into a conical surface and combining the same with the double inclined plane."

215. For an *Improvement in Soap Cutting Machines;* Anton Van Haagen, Cincinnati, Ohio.

Claim.—"The ranges of vertical wires at right angles to each other, in combination with the drivers moving at right angles to each other and the ranges of rollers, for the purpose of cutting blocks of soap directly into slabs and bars at one operation and without handling thereof."

216. For an *Improvement in Soap Cutting Machines;* Anton Van Haagen, Cincinnati, Ohio.

Claim.—"1st, The arrangement and combination of a series of wires for cutting soap, said wires being stretched by means of springs for the easy formation of a loop at the commencement of cutting and gradual increase of tension until the wire has entered the block. 2d, The combination of grooved carriage, grooved driver, stationary and vertical range of horizontal wires and descending horizontal range of horizontal wires, for the purpose of slabbing and barring a block of soap without handling the latter after it is once placed upon the machine. 3d, The bed or carriage and driver scored transversely by grooves adapted to the loop of the wires."

217. For a *Method of Operating Steam Valves;* Norman W. Wheeler, Cincinnati, O.

Claim.—"1st, Actuating the induction and eduction valves of any double acting reciprocating steam engine by means of steam pressure derived from the working cylinder, and released therefrom by the passage of the working piston over and beyond appropriate ports, when the pistons, or their equivalents, upon which such pressure acts, are so arranged, that no movement of the valves shall result from the passage of the working piston over the first of two or more such ports in any full stroke. 2d, Releasing the steam contained between pistons of unequal areas by the passage of the larger one over its exhaust port, and stopping the supply between the same pistons by the passage of the smaller one over its induction port."

218. For an *Improvement in Direct Acting Hydraulic Steam Pumps;* Henry R. Worthington, Brooklyn, New York.

Claim.—The mode of counteracting the resistance to the motion of the pump piston in direct action pumping engines by which the steam valve is moved, that is to say, by making a passage into the pump chamber or cylinder, so arranged, that said passage or

opening shall, for a time, be uncovered or disclosed at or near the end of each stroke of the piston, by which the fluid, which is beyond or above the force valves, passes behind the water piston, and makes pressure thereupon in the direction of said piston's motion."

219. For an *Improvement in Writing Desks;* William G. Wolf, Philadelphia, Pa.

Claim.—"The horizontal inclined levers, and inclined and declined planes, with the upright traveler working thereon, which causes a graduation, that of a desk to be formed or else entirely concealed, at pleasure, using for that purpose the horizontal inclined levers, inclined planes, and upright traveler."

220. For an *Improvement in Washing Machines;* Samuel M. Yost, Connersville, Ind.

Claim.—"The arrangement of two corrugated rollers, one above and washing into the other without coming into contact in the lowest lines, and each being tightly covered with canvass or other strong material, the whole combined and operating in such a manner, as to effectually wash any cloth submitted to it, and without breaking the buttons or other similar hard substances upon the linen or cloth."

221. For an *Improvement in Seeding Machines;* Lucien N. Bigelow, Cuba, N. Y.

Claim.—"The use of a screen for the purpose of sowing grain broad-cast, so arranged with a feeding hopper and slides, as to regulate the quantity of grain to be sown when acted upon by trip-hammers to secure its uniform and proper distribution."

222. For an *Improvement in Hot Air Furnaces;* Samuel A. Briggs, Providence, R. I.

Claim.—"The passage leading from the chamber to the hot air chamber in combination with the damper, crank, and rod."

223. For an *Improvement in Ovens;* John P. Hayes, Philadelphia, Pennsylvania.

Claim.—"1st, The pipes or hot air flues extending up one or more of the heating flues of an oven, the same opening into the oven near both the top and bottom of the same, so as to form a communication between the upper and lower strata of air in the said oven through the gas flue or flues in which they are located, and the said flues opening also near the bottom of the same to the outside of the said oven for the purpose of admitting fresh air into the oven. 2d, Making the partition plate so as to move or yield upwards, when the same is used in combination with the movable box or lining of an oven, for the purpose of allowing the ready admission or withdrawel of the said movable box, as occasion may require."

ADDITIONAL IMPROVEMENTS FOR JULY, 1855.

1. For an *Improvement in Screw Wrenches;* Lorenzo D. Gilman, Troy, New York; dated July 19, 1855; original patent dated March 27, 1855.

Claim.—"Adding the tube with the nut surrounding the rod of the movable jaw to the arrangement of the adjustable toothed plate with springs, the toothed shank, and the eccentric with its strap attached to the toothed plate."

2. For an *Improvement in Fire Arms;* Frederick Newbury, Albany, New York; dated July 31, 1855; original patent March 20, 1855.

Claim.—"The construction and arrangement of the hammer and trigger with their parts as substitutes for the sear lever and tumbler. Also, the ratchet action plate with its cam slot as a substitute for the ratchet lever and ratchet pawl. Also, the cylinder spring stop lever as fitted and applied as a substitute for the united actions of the click lever and stop catch lever. Also, the combination of the hammer, trigger, ratchet action and cylinder spring stop lever to operate jointly in the process of firing. Also, the apparatus for detaching and re-attaching the barrel to the stock, viz: the bent lever lying in a recess within a metal projection from the barrel, with its catch at its back end, fitted to hold into a notch in the stock and kept in place by a spring lying within the said recess, in combination with the hinge plate, this arrangement being a substitute for the thumb connecting plate."

RE-ISSUES FOR JULY, 1855.

1. For an *Improvement in Machinery for Felting Hat Bodies;* William Fuzzard, Charlestown, Massachusetts; dated July 10, 1855; original patent dated January 13, 1855.

Claim.—"Giving the felting action by means of the moving apron to receive the article or articles to be felted within the fold thereof, and there confined and compressed by the rollers, or their equivalent, acting on the apron."

2. For an *Improvement in Corn Planters;* Samuel Malone, Tremont, Illinois; dated July 10, 1855; original patent dated January 3, 1855.

Claim.—"The peculiar construction of the horizontal slide made reversible from end to end for the purpose of varying the quantity of seed planted."

3. For an *Improved Portable Grinding Mill;* Lyman Scott, St. Louis, Missouri; dated July 10, 1855; original patent dated May 16, 1854.

Claim.—"The alternate deep and shallow sections of furrows upon the main grinding surface of the burr, for the purpose of distributing the material over said surface and preventing a surfeit or clogging upon any one point of said grinding surface. Also, the method of supporting the shell and adjusting the burr therein by means of the lower bridge-tree, grooved legs, sockets, and adjusting screw rods, when said legs served the double purpose of supports to the shell and guides to the bridge-tree. Also, the arrangement of driver, arms, burr, and shell, constructed so, that the several operations of breaking the ear, cracking the cob, and grinding into meal, may be all conducted without straining the mill or power applied."

4. For an *Endless Chain Horse Power;* George Westinghouse, Central Bridge, New York; dated July 19, 1855; original patent dated June 13, 1854.

Claim.—"The construction and attachment of the gearing, having a hub or pinion permanently affixed on the ends of each shaft, to either of which the centre caps or hubs of either the driving or band wheels fit and are fastened."

5. For an *Improvement in Cotton Presses;* Cyrus J. Fay, North Lincoln, Maine; dated July 17, 1855; original patent dated January 31, 1854.

Claim.—"1st, The use of the slats or guide strips. 2d, The tenons upon the transverse bars of the doors, which, entering mortises in the frame work, relieve the hinges from the strain which would otherwise come upon them. 3d, Hinging the doors of the press to prevent them from violently bursting open when the bar which confines them is removed."

6. For an *Improvement in Machinery for Dressing Treenails;* Delia A. Fitzgerald, Assignee of Jesse Fitzgerald through Josiah Pierce, City of New York; dated July 17, 1855; original patent dated August 28, 1849.

Claim.—"The use of the cutters in combination with the enlarging and heading apparatus, or apparatus analogous thereto, and this, whether any one or more of the parts of the enlarging and heading apparatus, or apparatus analogous thereto, are used separately or collectively in combination with the said cutters, whereby treenails are cut and shaped by the use of such mechanical devices."

7. For an *Improvement in Looms for Weaving Figured Fabrics;* Richard Garsed, Frankford, Pennsylvania; dated July 24, 1855; original patent dated November 6, 1849.

Claim.—"Operating the headle frames by the application of a cylinder having two or more patterns interchangeable at pleasure. 2d, The employment of two or more distinct patterns simultaneously in the same loom interchangeable at pleasure. Also, the apparatus for turning the cylinder, whereby it can be moved through a great or less space, as may be required."

DESIGNS FOR JULY, 1855.

1. For *Cooking Stoves;* Russell Mann, Troy, N. Y., Assignor to G. W. Eddy, Waterford, New York; dated July 3, 1855.

Claim.—"The ornamental design and configuration of stove plates."

2. For *Spoons;* Henry Hebbard and John Polhemus, City of New York; dated July 3, 1855.

Claim.—"The use and arrangement of the ornamental devices for ornamenting the front of the spoon and back of the spoon, or either of them, in combination with the spoon or other similar article of table cutlery."

3. For *Franklin Fire Places;* Nathaniel P. Richardson, Portland, Maine, dated July 31, 1855.

Claim.—"The ornamental design of the stove and particularly that of each of the members."

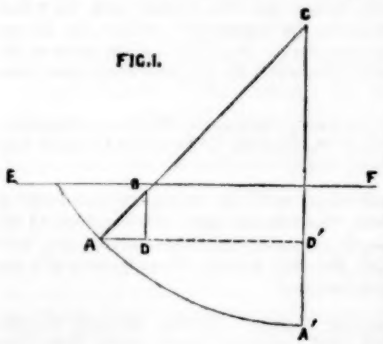
MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Remarks on the Relative Efficiency of the "Common Radial" and the "Feathering" Wheels.

It is generally admitted that the total loss of effect, or power, in the common radial wheel, is the sum of the losses of the oblique action of the paddles on the water and the slip. The former is calculated by taking the mean of the squares of the sines of the angles of incidence at which the paddles strike the water, or, which is the same thing, the mean of the squares of the cosines of the angles of the arm and water; for one angle is the complement of the other. This will appear plain from an inspection of figure 1. A C is the arm making any angle at C, with the vertical line, C A′; A B the breadth of the paddles, and E F the surface of the water. Now, it is manifest that, inasmuch as the vessel is moving in a horizontal direction, the line B D, at right angle to that direction, represents the only portion of the paddle, A B, that is efficient in propelling the vessel, and the line, A D, represents that portion of the paddle that tends to lift the vessel out of the water, which, consequently, as it produces no propulsive effect, must be entirely lost. But the line, A B, being the breadth of the paddle, represents the force applied to it, which is divided into two other forces, A D, which tending to lift the vessel, is the loss, and B D, at right angle to the vessel's path, is the efficient force, or the portion that is utilized in propelling the vessel. The two together, however, cannot exceed the total force applied, viz: A B; and, by the nature of right

FIG. 1.



angled triangles, the sum of the squares of A D and B D are equal to the square of A B, and A B representing the power applied—which we will consider unity—the square of B D will be the square of the natural sine of the angle B A D, and the square of A D, the square of the natural sine of the angle A B D. But the triangles A B D, A C D′, being similar, the angles at B and C are equal, and the loss of effect is therefore simply represented by the square of the sine of the angle that the oblique arm makes with the vertical one, but as the angle is continually changing as the arm moves through the water, we have to take the mean, and the more numerous therefore the divisions are made, the nearer correct will be the result.

Thus: supposing, as per figure 2, a wheel of 26 feet diameter, 6 feet immersion of lower edge of paddles, and 20 inches breadth of paddles, the loss from oblique action is calculated as follows, the arc being divided into divisions of 5° each, which are considered sufficiently numerous for practical purposes:—

	Angles of incidence.	Sines of the angles of incidence.	
½	55	·81915	·33550 = half of the square of sine.
1	50	·76604	·58681 = square of sine.
1	45	·70711	·50000 = "
1	40	·64279	·41317 = "
1	35	·57358	·32899 = "
1	30	·50000	·25000 = "
1	25	·42262	·17860 = "
1	20	·34202	·11697 = "
1	15	·25882	·06698 = "
1	10	·17365	·03015 = "
1	5	·08716	·00759 = "
1	0	·00000	·00000 = "
1	5	·08716	·00759 = "
1	10	·17365	·03015 = "
1	15	·25882	·06698 = "
1	20	·34202	·11697 = "
1	25	·42262	·17860 = "
1	30	·50000	·25000 = "
1	35	·57358	·32899 = "
1	40	·64279	·41317 = "
1	45	·70711	·50000 = "
1	50	·76604	·58681 = "
½	55	·81915	·33550 = half of the square of sine.
22			5·62952

As 22 : 5·62952 : : 100 : 25·588 per cent. of the power applied to the wheels.

Half of the square of the sine at the angle of 55° is taken, because the paddle in that position is only half immersed, consequently only half the power can be expended on it as if entirely immersed; and the angles are put down twice because the losses are the same after the arm leaves the vertical position as before it reaches it. The effect in the former case being expended in forcing the water downwards, and in the latter case

in lifting the water, neither of which assists in propelling the vessel, the only tendency being to lift the bow and depress the stern.

The loss from slip is usually considered the difference between the velocity of the centre of pressure of the paddles and the velocity of the vessel.

Thus, if the velocity of the centre of pressure of the paddles exceed the velocity of the vessel by 18 per cent. of its speed, 18 per cent. is considered the loss of effect from slip. This, we conceive, to be an error. The 18 per cent. is the difference between the velocity of the wheel and the velocity of the vessel, nothing more, and therefore simply represents the slip in per cent. of the speed of the wheel, but not the *loss* of effect from slip. For it has been shown, that the loss resulting from the oblique action of the paddles on the water is as the squares of the sines of the

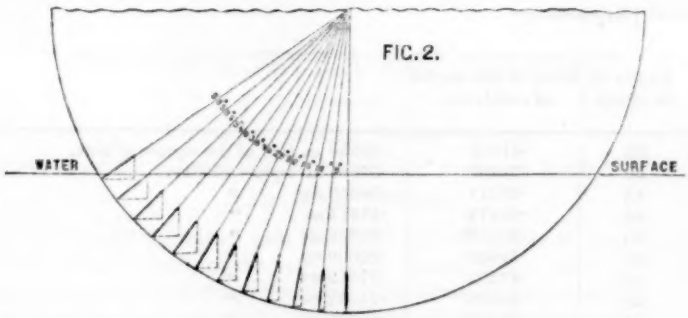


FIG. 2.

angles of incidence, and if we suppose the wheel to be immersed to its axis, the loss from this cause on the paddle when in the horizontal position—the angle being 90°—is 100 per cent., and if the loss from slip of 18 per cent. be added to that, we have a total loss of 118 per cent., or more than the power applied. A positive absurdity. Or, again, supposing the vessel to be made fast to the wharf, the difference between the velocity of the paddles and the velocity of the vessel will be 100 per cent., and as the loss from oblique cannot, from this circumstance, be any less than if the vessel was going ahead, there will be a total loss of the power applied to the wheels of 125·588 per cent.

At the angle of 45° it has been seen that only one-half of the area of the paddle is effective in propelling the vessel, and the other half is lost in oblique action. Now, then, if 18 per cent. is the loss from slip when the whole area of the paddle is effective, as it is in the vertical position, when only half the area is effective, the contents of the column of water driven aft in the same time can be only half, consequently requires only half the power to do it, and the loss therefore in that position cannot exceed half of 18, or 9 per cent.; at the angle of 30°, where three-quarters of the paddle is effective, the loss is $\frac{3}{4}$ of 18 = 13·5 per cent. Thus we see the loss from slip goes on decreasing from the vertical to the horizontal position, at which place it becomes nothing. We can, therefore, approximate very nearly to the true loss, in the present radial wheel, by

taking the mean of these losses at the angles as laid down in figure 2. They are as follows:—

At 0° = 18—	·0000 =	18·	per cent.
" 5 = 18—	·1366 =	17·8634	"
" 10 = 18—	·5427 =	17·4573	"
" 15 = 18—	1·2056 =	16·7944	"
" 20 = 18—	2·1055 =	15·8945	"
" 25 = 18—	3·2148 =	14·7852	"
" 30 = 18—	4·5000 =	13·5000	"
" 35 = 18—	5·9218 =	12·0782	"
" 40 = 18—	7·4371 =	10·5629	"
" 45 = 18—	9·0000 =	9·0000	"
" 50 = 18—	10·5626 =	7·4374	"
" 55 = 18—	12·0780 =	2·9610	"
	2	138·3343	
		2	
Doubled for both sides of the vertical position,		276·6686	
		18·	
		294·6686	

$\frac{294{\cdot}6686}{22} = 13{\cdot}394$ per cent. of the power applied to the wheel.

The same result is obtained as follows:—

100·000 (power applied)—25·588 (oblique action) × 18 per cent. (slip of the vertical paddle) = 13·394 per cent.

We have, then, for a total loss in this radial wheel, 25·588 + 13·394 = 38·982 per cent. of the power applied to it.

Feathering Wheel.—Let us take a feathering wheel of the same diameter of centre of pressure, *i. e.* 26 ft. 4 in. in diameter from outside to outside of paddles—same immersion, breadth, and number of paddles, and see how it compares with this.

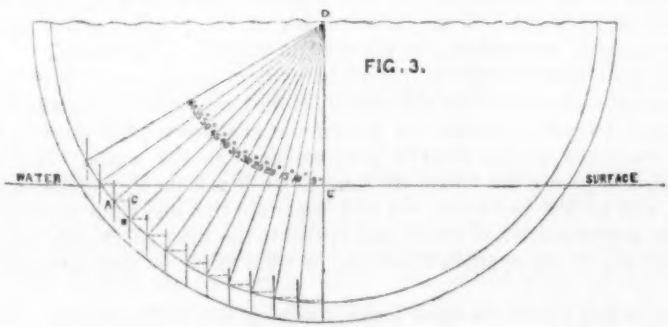


FIG. 3.

It is conceived by some, that the only losses in this kind of wheel are the friction of the eccentrics, &c., and the slip, but there is another loss, with deep immersions or light slips, occasioned by the *drag* of the paddles as they enter and leave the water. In figure 3, the paddles are

supposed vertical from the time they enter until they leave the water, and the positions of the arm will be seen at the degrees there laid down. The perpendicular lines drawn across the arcs are intended to represent the breadth of the paddles. It is plain that while the axis of the paddle moves from A to B, it moves horizontally the distance A C, and vertically the distance C B, and, supposing the vessel to be moving with the same velocity as the paddle, it will travel the distance A B, while the paddle travels horizontally the distance A C. Now, the distance A C, being less than A B, the paddle, in this position, cannot be giving out any power, but must be keeping the vessel back, by carrying a column of water in front of it, the base of which is equal to the area of the paddle, and length equal to the difference in lengths of the two lines.

If A B be represented by unity, A C will be represented by the natural sine of the angle A B C, and if the arc be supposed to be divided into an infinite number of parts, or composed of an infinite number of straight lines, A B will be at right angle to A D, and by consequence, the angle A B C, will be equal to the D A E, and as the sine of B, represents the distance traveled horizontally by the paddle, the sine of A must manifestly represent the same thing, but the sine of A is the cosine of D, which therefore represents the horizontal velocity of the paddle at the angle of 50°, its circular velocity being 1. The difference between these two lines is, therefore, the loss from *drag*, supposing there to be no slip; but as all paddle wheels must have some *slip* when they are propelling a vessel, the line A B diminished by the amount of slip will represent the distance traveled by the vessel, and the loss from drag will therefore, instead of being the difference between A B and A C, be the difference between a fraction of A B and the whole of A C, dependent upon the amount of slip. If this fraction of A B be just equal to A C, the loss from drag in that position becomes 0; for though the paddle be giving out no power to the vessel, it occasions no resistance to the vessel's progress through the water, because it is moving horizontally precisely as fast as the vessel itself; and if the fraction be less than A C, the resistance will, of course, be on the after instead of the forward side of the paddle, and it must, in consequence, necessarily, be assisting in propelling the vessel.

Now, then, from the above, it must be evident to any one, that so long as the paddle, after it enters the water, is moving horizontally at a less rate than the vessel, it cannot be giving out any power, but must be an actual resistance to the vessel's progress through the water. Taking figure 3, and giving the wheel the same mean loss from slip as the radial wheel, viz: 13·394 per cent., we will ascertain the loss from slip at the different angles there laid down, and attend to the drag afterwards, which is merely slip in the opposite direction, or what might be termed *negative* slip.

To give this wheel the same mean loss from slip as the radial wheel, it has to have on the arm when in the vertical position or

Cosines.

At 0°		26·225 per cent.
" 5	=99,619—·73,775=	25·844 "
" 10	=·98,481—·73,775=	24·706 "
" 15	=·96,593—·73,775=	22·818 "
" 20	=·93,969—·73,775=	20·194 "
" 25	=·90,631—·73,775=	16·856 "
" 30	=·86,603—·73,775=	12·828 "
" 35	=·81,915—·73,775=	8·140 "
" 40	=·76,604—·73,775=	2·829 "
" 45	=	0·000 "
" 50	=	0·000 "
" 55	=	0·000 "
		134·215
		2
Doubled for both sides of the vertical position,		268·430
		26·225
		294·655

$\frac{294·655}{22}$ = 13·394 per cent. of the power applied to the wheel lost by slip. At the angle of 55°, the paddle is ·445 part immersed, but, being so near, we have taken it at a half for simplicity, and for like reason have considered the paddle at 50° entirely immersed.

It will be seen from the above, that the paddle, from the time it enters the water until after it passes 45°, is traveling horizontally at a less rate than the vessel, and the same effect ensues as it rises out of the water; there must, therefore, be a loss from drag or negative slip. Let us see what this amounts to.

Cosines.

At 55°	=$\frac{·73,775—·57,358}{2}$=	8·208 per cent.
" 50	=·73,775—·64,279=	9·496 "
" 45	=·73,775—·70,711=	3·064 "
		20·768
		2
Doubled for entering and leaving,		41·536

$\frac{41·536}{22}$ = 1·933 per cent.

We have then, for a total loss in this wheel, slip (13·394 per cent.) + drag (1·933 per cent.)=15·327 per cent. of the power applied to it.

The total loss in the radial wheel having been shown to be 38·982 per cent. and in the feathering wheel 15·327 per cent., we have 23·655 per cent. in favor of the feathering wheel. But of the whole power applied to the engines, about 20 per cent. is expended in overcoming friction of do., friction of load on working journals, working air and feed pumps with their load, &c., consequently, only 80 per cent. reaches the wheels, and 23·655 per cent. of 80 per cent. equals 18·924 per cent. of the total power applied to the engines in favor of the feathering wheel.

To stand off against this, we have the friction of the eccentrics, &c., (an amount that, perhaps, can only be estimated,) extra weight and wear and tear of wheels.

It will be seen, also, from the above, that the difference between the velocity of the feathering wheel and the vessel being 26·225 per cent. of the speed of the wheel, and the difference between the velocity of the radial wheel and the vessel being 18 per cent. of its speed, it follows that, making the same number of revolutions, the speeds of the vessels will be as 73·775 to 82, or as 1·00 to 1·11, consequently, the speed of the feathering wheel will have to exceed the speed of the radial wheel 11 per cent. to give the vessels the same velocity, but this speed of the wheel is as shown—consequent upon there being less resistance to the paddles—attained by an expenditure of 18·924 per cent. less power.

Centre of Pressure.—The centre of pressure of a rectangular plane immersed in a fluid, the upper extremity of which is even with the surface of the fluid, is $\frac{2}{3}$d from the bottom; but, inasmuch as the pressure is as the depth, when its upper extremity is below the surface of the fluid, this law no longer holds good. To ascertain the centre of pressure in this case, Jamieson on Fluids gives the following practical rule:

"Divide the difference of the cubes of the extremities of the given plane below the surface of the fluid by the difference of their squares, and two-thirds of the quotient will give the distance of the centre of pressure below the surface, from which subtract the depth of the upper extremity, and the remainder will show the point in the centre line of the plane in which the centre of pressure is situated."

This rule can be applied directly to the feathering wheel by taking the mean immersion of the paddles as they move through the water, and assuming figure 3 to be of the same diameter from outside to outside of paddles, as figure 2, viz: 26 feet, we find the mean immersion of the lower edge of the paddles after their upper extremity gets below the surface to be

$$\left(\frac{29{\cdot}23+37{\cdot}84+45{\cdot}59+52{\cdot}44+58{\cdot}32+63{\cdot}09+67{\cdot}02+69{\cdot}78+71{\cdot}44}{19}\right)$$

$2+72=55{\cdot}87$ inches, and upper edge 35·87 inches.

The mean centre of pressure of the paddles, then, in these positions, is

$$\left(\frac{55{\cdot}87^3-35{\cdot}87^3}{55{\cdot}87^2-35{\cdot}87^2}\right)\frac{2}{3}-35{\cdot}87=46{\cdot}59-35{\cdot}87=10{\cdot}72$$

inches from top, or 9.28 inches from bottom, and the mean centre of pressure from the time the paddle enters until it leaves the water $=\frac{9{\cdot}28\times19+(6{\cdot}62+3{\cdot}25)2}{23}=$ 8·52 inches from the bottom.

In the radial wheel, however, as the outer extremity of the paddle moves more rapidly than inner extremity, and as the resistance is as the square of the velocity, the centre of pressure must be considerably nearer the outer extremity on this account. One-third from the bottom, in this case, is therefore, probably, not much out of the truth, but as a portion of the paddle only, part of the time is immersed, we take the mean of the third of that portion and a third of the whole breadth of the paddle during the time it is entirely immersed. Thus, $\frac{(20\div3)21+(10\div3)2=}{23}$ 6·37 inches from bottom, showing the centre of pressure under these circumstances to be (8·56—6·37=) 2·15 inches nearer the lower edge of the paddle in the radial wheel than it is in the feathering wheel. K.

For the Journal of the Franklin Institute.

Performance of the U. S. Steam Frigate "Powhatan."

Much has been recently said and written on the failures and inefficient performances of steamers belonging to the U. S. Navy, and it has been carried to such extent in some instances as to leave the impression that all the steamers of the Navy are abortions, without taking into consideration the difference of construction, size of masts, spars, &c., between a man-of-war as now constructed, and a merchant vessel, and the facility a steamer of the latter class has for repairs, compared with a man-of-war on a foreign station. Leaving, however, the causes of the failures or success of the steamers of the Navy to be assigned by those most interested, it may not be amiss, under existing circumstances, to make a few remarks on one, the "*Powhatan*," that has proved herself to be the swiftest, if not the most superior man-of-war steamer afloat, and for this purpose, we select her run between Shanghai and Hong Kong, China, on the 28th, 29th, 30th November, and 1st December, 1854, as showing the mean of her performance under sail and steam combined, but as a simple statement of her performance would be nearly useless without the dimensions of the ship and engines, we insert the principal ones as follows:

HULL.—

Length of keel,	246 feet.		
" " between perpendiculars,	250 "		
" " at load line,	250 "		
" " on deck,	251 "	6	inches.
" " from billet to taffrail, (extreme,)	276 "	6	"
Breadth of beam (moulded.)	44 "		
" " over guards,	69 "	6	"
Depth of hold,	26 "	6	"
Tonnage, 2419 32-95.			
Area of immersed midship section at load line,	675 sq. feet.		
Draft of water at load line,	18 feet	6	inches.
Mean draft of water aft during the above passage,	18 "	4	"
" " forward " "	17 "	2	"
Depth of keel below planking,	1 "	6	"
Displacement of hull at load line, 3535 tons (2240 lbs.)			
" " per inch " 22·9 "			

Hull built of live oak and copper fastened. Launching draft, 11 feet 4 inches=1600 tons including 18 inches of keel. Barque rigged, but the wheel houses prevent the main-sail from being set, and it is, therefore, never bent.

ENGINES.—Direct acting.—

Two inclined cylinders set at an angle of 30° 15′ with the keelsons.

Diameter of each,		70	inches.
Stroke of piston,	10 feet.		
Diameter of wheels,	31 "		
Number of arms in each wheel,	23 "		
Single paddles: length of ditto,	10 "		
Depth of "	2 "	2	inches.
Mean immersion of lower edge of paddles during the above passage,	4 "	8	"

Condensers, 95 cubic feet in each.

Air-pumps, vertical—52½ ins. diam. by 42 ins.; stroke of piston,=51·8 cub. ft. in each.

Feed pumps, 8 ins. diam. by 42 inches; stroke of plunger=2111 cubic ins. in each.

The "*Powhatan*" hove anchor at Woosung, a few miles below Shanghai, 6·30 A. M., the 28th November, and at 5 P. M., December 1st, made Ly-u-moon Passage; received a pilot on board, and at 6·30 anchored in Hong Kong harbor, making a total time, including difference of time between the two places, 84½ hours from the time the anchor was hove until let go. The speed of the ship appears, however, from the ship's log book, to have been logged only from 4 P. M., the 28th, to 2 P. M., the 1st, but as this constitutes the principal part of the passage, it will be sufficient for our present calculations. The following is an abstract of the steam log:

Time.	Knots per hour (per chip log.)	Revolutions of engines per minute (per counter.)	Pressure of steam above the atmosphere (per steam gauge.)	Vacuum in condenser.	Point of cutting off from commencement of stroke.	Throttles.	Coal.	Ashes and clinker.	Sea.	Wind.
			lbs.	ins.	ins.		lbs.	lbs.		
From 4 P. M. Nov. 28, to midnight,	10·406	12·57	10·9	26	34	Wide open.	32,800	4,290	Light abeam,	Moderate breeze abeam.*
Nov. 29th,	9·979	12·4	11·1	26	29·5		91,575	10,206	Moderate on the quarter,	Fresh top-gallant breeze on the quarter.†
" 30th,	10·708	13·74	11·1	26	28·5		98,750	7,088	" "	Fresh top-gallant breeze nearly aft.‡
From midnight to 2 P. M. Dec. 1st,	11·428	14·41	12·1	26	25		75,800	5,427	" "	Moderate breeze on the quarter.‖
			lbs.	ins.	ins.	"	per hour.	per cent.		
Means,	10·63	13·28	11·3	26	29·25		4.255	9·06		

* Fore and aft sails set.

† Sails furled from 4 to 10 A. M.; the remainder of the day fore and aft sails set: difference of time this day from running to westward, 15 minutes.

‡ Fore-sail and fore-topmast staysail set from midnight to 4 A. M.: at 9 A. M. set fore-topsail; at 11·30 A.M. set main-topsail; fore and main topsail and foresail set the remainder of the day.

‖ Fore and main top-sails and foresail set.

From a number of indicator diagrams, the back pressure in the "*Powhatan*" cylinders is shown to be about 3·5 lbs. per sq. in. of piston, and the initial pressure 1·5 lbs. less than the pressure per steam gauge: we have, then, from the above abstract, neglecting clearance and using Marriotte's law for the expansion of steam, as 4·1 (number of times the steam is expanded) : 2·411 (Hyᵉ. log.+1) : : 11·3+14·7—1·5 (initial pressure) : 14·77 lbs. mean pressure, and 14·77—3·5=11·27 lbs., mean unbalanced pressure per square inch of piston; and the power exerted by the engines

$$\left(\frac{11{\cdot}27\times 3848{\cdot}4\times 10\times 13{\cdot}28\times 2}{33{,}000}\times 2=\right)698{\cdot}15 \text{ horses.}$$

The power required to work the air-pumps, independent of friction, from indicator diagrams, is ·7 lbs. per square inch of steam pistons, and allowing for working the feed pumps, it will be somewhat augmented, say to 1 lb.=8·87 per cent. of the total power of the engines, and allowing 15 per cent. for overcoming the friction of the engines with their

load, there remains only 76·13 per cent. of the total power to be applied to the wheels. Let us see in what manner this is disposed of:

The circumference of the centre of pressure of the paddle boards, at the above immersion, is 93·6 feet, and using the number of feet given by Bowditch for a knot, we have the following for the slip of the wheels on the 28th:

93·6×12·57×60=70593·12=feet traveled by centre of pressure of paddles per hour.

6120×10·406=63684·72=feet traveled by the vessel per hour.

6908·40=difference, which is 9·784 per cent. of the speed of the wheel.

The slips on the 29th, 30th, and 1st, calculated in the same manner, are 12·302, 15·073, 13·576 per cent. respectively, giving a mean for all four days, of 12·684 per cent.

The slips of a paddle wheel is the difference between thevelocity of the centre of pressure of the paddles and the velocity of the vessel; and the loss from slip is this difference in per cents. of the speed of the paddles, multiplied, not into the total power applied to the wheels, but into the portion that remains after the loss from the oblique action of the paddles is deducted. Thus, in the present case, the power applied to the wheels being considered 100, and as the loss from oblique action at the above immersion is 15·085 per cent. the loss from slip is

(100—15·085×12·684=) 10·77 per cent. of the power applied to the wheels; giving a total loss for slip plus oblique action of (10·77+15.085 =) 25·855 per cent. But as only 76.13 per cent. of the whole power exerted by the engines reaches the wheels, we have 25·855 per cent. of 76·13 per cent.=19.683 per cent. of the total power of the engines for the sum of the losses of the wheels, leaving 56·447 per cent.=394 horses to be utilized in propelling the vessel.

Boilers.—Four copper boilers of the double return ascending flue *variety*, containing 8500 square feet of fire and flue surface, and 2300 cubic feet of steam room.

Length of flues including steam chimney 49 feet, grate surface 354 sq. feet, which has been reduced to 300 square feet by building brick bridge walls in the backs of the furnaces; proportion of grate to heating surface 1·00 to 28·33; coal consumed the hour per square foot of grate, 14·18 lbs.; water carried in the boilers at a density of $1\frac{3}{4}$ per Sewell's "Salinometers." The quantity of water evaporated per pound of coal, neglecting losses from radiation and leakage of the valves, we obtain as follows:—number of cubic feet of steam used per stroke, from the above abstract, including clearance of piston and space between the valves and cylinder=77·7, at a pressure of (11·3+14·7—1·5=) 24·5 lbs. per square inch, and the number of cubic feet used per hour in both cylinders=77·7 ×13·28×60×2=247645·44. The relative volumes of steam and water, at this pressure are as 1064 to 1; we have then $\frac{247645·44}{1064}$=232·749 cubic feet of water evaporated per hour, and considering a cubic foot of sea

water to weigh 64·3 lbs., we have $232·749 \times 64·3 = 14965·76$ lbs. of water evaporated per hour with 4255 lbs. of coal = 3·5 lbs. of water per pound of coal.

The temperature of the water in the hot well averaged 107° Fah. and the sum of sensible and latent heat of steam at (11·3 + 14·7 =) 26 lbs. per square inch, from the latest reliable experiments, is 1187·5° Fah. and the sensible heat alone 240° Fah. Carrying the water in the boilers at $1\frac{3}{4}$, that is, $1\frac{3}{4}$ lb. salt in 32 lbs. of water, and considering the sea water to contain 1 lb. of salt in 32 lbs. of water, we find the loss from blowing off thus:

Heat required to raise the feed water from 107° to 240° Fah. = 133°.
" " evaporate the water from 107° Fah. = 1187·5 — 107 = 1080·5°.

Now, then, since the water was maintained at a density of $1\frac{3}{4}$, one part that entered the boilers was blown out and the remaining $\frac{3}{4}$ part converted into steam, hence:—

$133 - \overline{1080·5 \times \frac{3}{4}} + 133 = 14·1$ per cent. of the total amount of fuel consumed in the furnaces; consequently the remaining 85·9 per cent. is that which evaporated the 3·5 lbs. of water, the 100 per cent. therefore, evaporates 4·07 lbs. of water per pound of coal.

This is an exceedingly low evaporation, and is about $2\frac{1}{2}$ lbs. less than is obtained from the same boilers with good anthracite coal. The bunkers being nearly empty, in the present instance, the coal consumed was in consequence, the scrapings, composed principally of very fine and dry bituminous, mixed with considerable dirt and fine anthracite. The rapid draft occasioned, therefore, much of it to be drawn through the flues and lodged in the connexions, which accounts for its showing only 9.06 per cent. of ashes and clinker.

It is probable also, the steam valves leaked to some extent, which has reduced the apparent evaporation somewhat.

From the above abstract it also appears, that the slip of the wheels with the fore and aft sails set, and a moderate breeze abeam, was less than when the square sails were set with a fresh breeze nearly aft, and a moderate breeze on the quarter. It is probable, therefore, from this, that the speed of the vessel was over-logged on the 28th, but as the slip on the 30th and 1st, is very nearly what it would have been with no sail at all, it is also probable that she was under-logged on those days, rendering the mean speed, therefore, not beyond the truth.

With an unlimited supply of good coal, with the above immersion, under steam alone in smooth water, an average of 17 revolutions per minute can be attained without any difficulty for any length of time, and allowing 18 per cent. for slip, we have a speed of

$$\left(\frac{93·6 \times 17 \times 60 \times ·82}{6120} =\right) 12·8 \text{ knots per hour,}$$

which may be considered her maximum performance without the assistance of sails. K.

For the Journal of the Franklin Institute.

Particulars of the Steamer Lebanon.

Hull and Machinery built by James & George Thompson, Glasgow. Intended service, New York to Liverpool.

HULL.—

Length on deck from fore part of stem to after part of stern post, above the spar deck,	252 feet	6 inches.
Breadth of beam at midship section,	30 "	5 "
Draft of water at load line,	17 "	
" " below pressure and revolutions,	17 "	
Tonnage of hull independent of engine-room,	817·62	
Contents of bunkers in tons of coal,	400	
Masts and rig,	Barque.	

ENGINES.—Oscillating, placed fore and aft.—

Diameter of cylinder,		54 inches.
Length of stroke,	5 feet.	
Maximum pressure of steam in pounds,	15	
Cut off,	$\frac{1}{4}$	
Maximum revolutions per minute,	24½	

BOILERS.—Two—Tubular.

Description of coal,	Bituminous.
Draft,	Natural.
Consumption of coal per hour,	27 pounds.

PROPELLER.—

Diameter of screw,	12 feet.	10 inches.
Pitch of screw,	240	
Number of blades,	3	
Geared,	2½ to 1	

Remarks.—Frame of wrought iron $\frac{7}{8}$ to $\frac{5}{8}$ thick. Floors (Z L) *molded*, 5 inches;—*sided*, $\frac{5}{8}$ inches;—distance of frames *apart at centres*, 15, 16, and 17 inches. Has four water-tight bulkheads. Keelson of $\frac{5}{8}$ plate, 32 inches deep. H.

For the Journal of the Franklin Institute.

Description of Joslyn's Double Acting Pump. By H. HOWSON, C. E.

The annexed engraving, represents a sectional elevation of a double acting pump for which a patent was granted to B. F. Joslyn, of Worcester, Massachusetts, in April last.

In designing this pump, the object of the inventor has been to maintain the flow of water to and from the barrel, in as direct a line as possible, and to avoid the tortuous passages which usually occur in double acting pumps, and which present such serious impediments to their efficient working.

In Joslyn's pump the barrel A, is a plain tube of brass maintained in its proper vertical position by the top and bottom of the air vessel J. The top of the barrel fits into an annular groove in the cover K, and the bottom, in a similar groove cut for the purpose in the flanched valve seat F.

The yielding substance of the packing, used in attaching both cover and seat to the air vessel J, allows the barrel A, to be bound tight between the two.

B is the pump piston or bucket, composed of two metal disks, with leather packing between, and turned up on their edges in the usual manner.

Into the bucket is screwed the suction tube C, above the orifice of which, and on the top of the bucket, is a valve opening upwards. The tube C, is carried down so far that its end may, as the pump operates, be always submerged in the reservoir below.

D is the pump rod, connected to the bucket B by the arched piece G, which is of such a form as to allow the valve on the bucket to work freely.

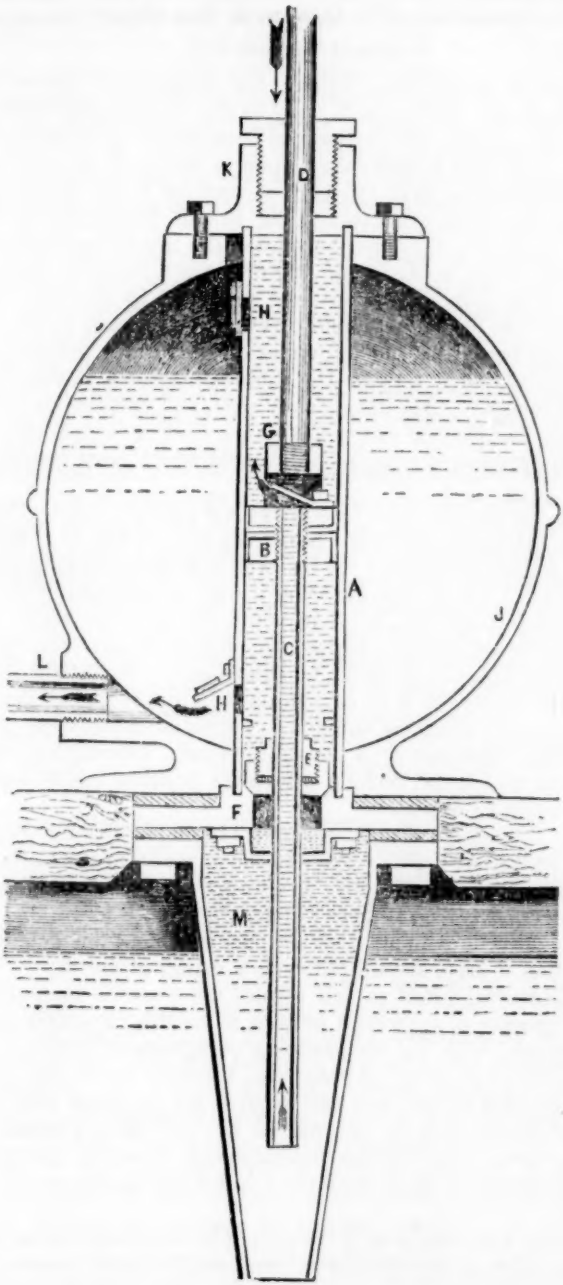
The rod passes through the stuffing box on the cover K, and is connected above to any suitable handle or other conveniently driving apparatus. E is a valve composed of two pieces, one screwed into the other with a light packing substance between, and through this valve passes the tube C easily enough to allow the valve to work with freedom, the packing at the same time preventing any leakage. The valve E, is prevented from rising too high by projections on the inside of the barrel, and the tube C, is guided by a guard under the seat F. The barrel is furnished with upper and lower discharge valves H, and the air vessel with the discharge pipe L. M is the main suction pipe with flanches on the top to secure it to the under side of the air vessel, the same fastening serving for the valve seat F.

On the descent of the bucket B, as shown in the engraving, the suction valve E, and upper discharge valve H are closed, and the water in the barrel below the piston is forced through to the lower discharge valve, into the air vessel, and through the pipe L, to its destination; at the same time the water from the reservoir rises in the tube C, passes through the bucket valve, and fills the space above.

On the upward motion of the bucket, the lower discharge valve H, is closed, and the valve E, opened, while the bucket valve being closed, and the upper discharge valve open, the water above the bucket is forced through the latter into the air vessel, and through the pipe L, at the same time a fresh supply of water is admitted through the main suction pipe M, and valve E, to the space below the bucket preparatory to being again discharged on the descent of the piston.

The simple method of securing the barrel, which is a plain brass tube, inside the air vessel, together with the peculiar arrangement of suction tube and valves, renders the whole a double acting pump of most economical and durable construction, while the flow of water throughout being nearly in a direct line, a less degree of power is expended in operating the machine than is employed in other pumps, while the supply of water is more efficient and regular.

The whole apparatus is easily taken in pieces, and as easily repaired when out of order, which recommends it as a pump peculiarly adapted to agricultural purposes; it may with equal advantage be used in all cases where a simple and efficient pump is a desideratum.


K
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*Correction of the Compass in Iron Ships.**

(Continued from page 120.)

For the reasons stated in my letter in the *Athenæum* of November 11, I have not been able until now to reply to the observations of Mr. Airy, "On the Correction of the Compass in Iron Ships," published October 28. Such reply I feel myself called upon to make, not merely because Mr. Airy's observations have reference throughout to my papers on corresponding topics, communicated to the British Association at its late meeting, in Liverpool, but rather because of the importance to commerce and humanity of the obtaining of safe or correct compass guidance in iron ships. The method of adjustment suggested by Mr. Airy being of such prevalent use in the mercantile navy, it is obviously of the highest possible consequence that the principles on which it is founded should be strictly sound; for if they be not sound—or, much more, if they be essentially erroneous—then danger may arise, and catastrophe in life and property may be expected to result from a confiding dependence by the navigator on a process of compass adjustment which must necessarily be delusive.

Now, the question at issue betwixt us is essentially this: —Mr. Airy contends for the soundness of the principles of his mode of compass adjustment; I for the converse. He believes it, if properly arranged, to be correct and safe; I aver that, however it may be arranged, it cannot be correct,—and, if relied on, must in many cases dangerously mislead. The question, being one of such vast importance, demands our best consideration, and should, if possible, be determined. Whilst the discussion of it, therefore, is sought to be carried on with due regard to those amenities which are the ornament and grace of scientific controversy, the question claims to be discussed with that full, free, and unrestrained reference to experience and truth, without which no positive useful conclusion could reasonably be expected.

The most convenient course, as appears to me, for this discussion will be, to take up the leading statements in the paper "On the Correction of the Compass," by which Mr. Airy's views are sought to be established, or mine controverted. And if these statements, in both forms, can be conclusively negatived, as to me it seems they can, then the determination of the question at issue should follow as a matter of course,

Let me, however, guard myself against the possible supposition that there is no measure of agreement betwixt us on this important question. On the contrary, with the commencing paragraph of section v, where inference is drawn from my experiments, I mainly agree, viz.:—"That the source of local disturbance and its laws are perfectly well known; that the disturbance can be neutralized by well known means to the greatest exactness; and that this neutralization is perfect during change of time and change of place, until the ship herself undergoes an organic change."

But here my accordance with the principles stated serves but little towards the support of any yet known process of compass correction. It

* From the London Athenæum, December, 1854.

only extends "*until* the ship herself undergoes an organic change;" and my persuasion is, as it will be my aim to prove, that the ship herself is *most* liable to undergo such change at any period of time, and, under the fitting circumstances, in any latitude or region. If this were not so, or if such organic changes were not likely to occur except at long intervals of time, or many years,—then the process of correction by Mr. Airy might have been as effectual in operation as it is elegant in conception. But the converse of this supposition will, if I mistake not, demonstratively appear in the discussion of the views or statements which we gather from the paper "On the Correction of the Compass in Iron Ships." The views of Mr. Airy comprised in the third section of the paper, it may be convenient, in the first place, to make the subject of inquiry.

I. *Whether the shocks of the sea on the iron plates of a ship have the quality of impact sufficient to render my experiments by percussion, &c. applicable for indicating the probable results in magnetic changes?*—The experiments of which Mr. Airy makes courteous notice,—which are described briefly under the record of the proceedings of the late meeting of the British Association in the *Athenæum* of October 7,—relate to the phenomena, and the laws by which these are governed, as to magnetism developed in malleable iron by percussion or other mechanical action. The original discovery of the phenomena dates so far back as the year 1819, and the most characteristic results were communicated to the Royal Society of Edinburgh, first in 1820, and more fully in 1821, in an account of a new instrument, a *magnetometer*, and experiments made with it.—(*Trans. of Roy. Soc. of Edin.* Vol. ix. pp. 243-258.) Other papers, I may here add, in the *Philosophical Transactions* for 1822 and 1824, on the development of magnetical properties of iron and steel by percussion, extended the original process to more complete results.

By these experiments it was shown that the influences simply exerted by induction of the earth's magnetism on malleable iron were vastly augmented by mechanical action; and that this augmentation of magnetism became so far fixed in the iron as to remain as if permanent until acted on by fresh mechanical violence in some other relation to the direction of terrestrial polarity. This quality of magnetism it is, for which I subsequently proposed the name of *retentive magnetism*.

Similar phenomena, under the same laws—in the magnetizing *retentively*, neutralizing or inverting the polarity—were shown, in my earliest experiments, to result from any process of mechanical action, such as scouring, filing, bending, twisting, or from concussion by falling, or from a shock of electricity; and the same rule was subsequently found to apply to thick plates of rolled iron, and the plates actually cut out of the fabric of an iron ship. In any and all cases, wherever magnetism had been developed by mechanical violence, similar action served to control, change, neutralize, or invert the polarity, under appropriate changes in position.

An extract from an article which recently appeared in some of the Liverpool papers will well explain the decisiveness and precision of the results of mechanical violence on the iron employed in ship-building:

"Dr. Scoresby, who has extended his stay in Liverpool with a view to promoting inquiries into the means of remedying the inconvenience and occasional misguidance of the compasses in iron ships, visited, on Tuesday last, several of our building yards,

having previously seen the Birkenhead yard of Mr. Laird. Accompanied by two or three gentlemen, who were witnesses of his experiments, he verified in a most remarkable and conclusive manner the deductions he had previously set forth at the meeting of the British Association at Oxford in 1847, and in his "Magnetical Investigations," published in 1852. In the yards of Messrs. Cato, Miller & Co., Messrs. Rennie, Johnson & Co., and Messrs. Vernon & Co., where several iron ships were in progress of construction, and from the proprietors of which he received every courtesy and attention, the magnetic action of the several ships on a delicate pocket compass, wherever they might be tried, was in exact agreement with his announcements before any trial was made. Thus, on approaching the bow of a ship, it was predicted that the south point of the compass would be attracted by the lower part of the stem, when, on making the experiment, the specified pole pointed directly to the part near which it was brought, so as, when the compass was carried from the starboard to the port side (round the foot of the stem), to make half a revolution of the needle. The like attraction of the north pole—the same being first notified—was as strikingly verified on ascending to the upper works of one of the ships, every portion of iron approached by the compass there showing strong southern polarity. A long slip of iron, picked up by Dr. Scoresby in one of the yards, was then made use of to test the principles he had elsewhere propounded respecting the terrestrially induced and retentive magnetism. Being struck a blow with a piece of wood (a wedge) in a suitable position, the iron slip was presented to the compass, whilst resting on a piece of timber, in a horizontal east and west position, where it exhibited no more influence than a piece of brass. The slip being raised up into a vertical position, the polarity of simple terrestrial induction was shown, which was reversed on reversing the iron. A blow with the wooden wedge, whilst the iron was held upright, elicited an intense energy of retentive magnetism, which was instantly reversed by striking the slip against a post the contrary way up, and finally neutralized by striking it again in a horizontal position. Again, a piece of old iron taken out of a ship was tested. It was part of an angle iron, or rib, belonging to the floor of a ship—of the shape, compressed, of the letter U. It was first placed with the ends on the ground and the convex edge upward (like a U the wrong way up), in an east and west line—the reverse of the position it occupied in the ship—and a single blow was struck against it with a large hammer. The original magnetism was instantly changed, and the ends resting on the ground, just according to theory, were found vigorously to attract the south pole of the needle, and repel the north. The angle-iron was then reversed, and the points held upward, in the position it had been fixed in when in use. One blow of the hammer reversed the polarity, and the upper ends of the U were found now to have energetic polarity attracting the north pole. The whole series of experiments, it may be added, were so striking and irresistibly conclusive, that they were looked upon by those present with unmixed admiration and surprise."

With these descriptions before him, the general reader will be enabled, I trust, to follow the course of reasoning by which I have endeavored to show that the positions taken by Mr. Airy are untenable.

Turning now to the views of Mr. Airy immediately before us, we find it admitted that causes exist tending to produce in iron ships effects like those exhibited in my experiments: but it is assumed that such causes are weak in efficiency and slow in operation. The latter article will come before us shortly.

Applying the principles elucidated by a large variety of experiments on various forms of iron, I had long ago predicted that changes—sudden and considerable they might be—would be liable to take place in the general or original distribution of a ship's magnetism by the mechanical violence to which the ship is exposed at sea from straining in gales of wind, blows from waves, or even the vibratory action of the engines of a steamer. But Mr. Airy's opinion seems opposed to the capability of such instrumentality being mechanically sufficient to produce any material effect.

As to strokes or shocks from the sea, Mr. Airy evidently underrates, and that in a measure that surprises one, the effective violence of the

waves. His words are:—"We may speak poetically of the shocks which a ship receives from the waves; but in reality the plates of iron of which a ship is composed sustain no such shock. The direct effect of the most violent sea upon them is this: that in the course of two or three seconds of time, the plate is plunged five or six feet deeper in the water, and sustains the corresponding hydrostatic pressure. This is very different, indeed, from the raps and slaps in Dr. Scoresby's experiments, in which it is essential that the blow be of the nature of impact, occupying a very small fraction of a second of time."

These words of Mr. Airy I quote in full, because if there were no reasonable proportion betwixt the mechanical violence in my experiments (as here assumed) and that impressed on a ship by the sea, then the argument, on my part, of similar effects could not stand. But it will be easy to show, I believe, that both the conditions are mistaken; that the quantity of mechanical action requisite to produce magnetic change is over-estimated, and the mechanical violence of the sea's action singularly underrated.

The sort of blows of the nature of impact, assumed in the reference to my experiments to be needful for the effecting of magnetic changes in iron plates or bars, it should be noted, is but one out of various processes by which similar effects are produced. The variety of mechanical action in the experiments referred to, may be thus sketched:—I take, for example, a slip of thin sheet iron of fifteen to twenty inches in length, and when free from all magnetism give it, whilst held in an upright position, a *blow* with some hard substance. The magnetism of simple induction is, by the augmentation of the *retentive* quality, increased to four-fold. I take the same plate, again neutralized, and give it a *slap* with the hand in an upright position, and the magnetic action of the earth is again quadrupled. Again, when reduced to neutrality, I give it a slight *flexure*, not sufficient to change the figure of the plate, and the effect is pretty nearly the same. Or, finally, I produce in it a *vibratory tremor*, to represent the tremor in a steamer, and the magnetic result, if not quite so great, does not fall far short of it. Then, reversing the position of the plate when the retentive magnetism has been most fully developed—any one of the processes described is found sufficient, not only to change the magnetical condition, but to reverse the polarity!

These experiments show that, whatever may be the *measure* of effect of mechanical action in developing or changing the magnetism in iron, absolute violence of the nature of impact is not necessary, as the slightest flexure or mere tremor *may* produce a change.

The mistake, in the passage quoted, as to the nature of the action of waves on a ship, is almost too obvious, were not the inquiry before us of such great importance, to require any argument. The naval reader, indeed, will smile at the mechanical limitation of the action of waves of thirty to forty feet high, and rolling with a velocity of twenty to thirty miles an hour, (as I have had opportunity of proving,) to a mere change of a few feet of hydrostatic pressure. For every sailor well knows the fact, that ships are perpetually liable in hard gales of wind at sea to be struck and receive shocks sufficient to make the whole fabric stagger,—to cause every mast and yard to quiver in sympathy,—and, not rarely,

to drive in bulwarks, and sometimes, in however rare cases, to start the very planks of a ship's upper works.

But a fact or two, as regards *iron* ships, should be conclusive in this matter,—both in respect to the powerful impact of waves, and their capability of producing organic changes in a ship's magnetism.

1. The *Great Britain*—whose adventures, in loss and recovery, form an a ticle in the history of iron ships—when passing round, I believe, our own coasts, was struck by a sea with such violence as to indent a portion of the bow and start some of the iron plates, or the water-ways from the contiguous plates, and to raise up the deck above!

2. The *Ottawa*, Capt. Atkins, in crossing the Atlantic, from Quebec to Liverpool, in October last—being then on her *eighth* passage—was struck by a sea which damaged bulwarks, boats, &c., and caused a remarkable change, as Capt. Atkins informed me, in the compass—a change as a gentleman interested in the ship assured me, had been previously described to him as amounting to about two points!

These two incidents, both of them well known, may be left to speak for themselves.

II. *Whether any rapid or sudden alteration or organic change in a ship's magnetic condition is, to any appreciable extent, likely, if indeed possible?*—Not to risk a misinterpretation of Mr. Airy's views, I shall take leave to quote his own statements. Referring to the probability of a change in the compasses of the *Tayleur*, as had been asserted, in an angle of two points, he says:—"I unhesitatingly answer, it is not likely." * * "And I aver there is no known instance of such a change,—and I do not believe an instance can be produced of a rapid change of one-fourth or one-tenth part of this amount."

As these views take us to the essential question, in the matter of experience, I shall be excused in first quoting what I believe to be *facts* of experience.

It is somewhat difficult to deal with the opinion above expressed in the calamitous case of the *Tayleur*, because that opinion is in such positive and direct opposition to the evidence taken at the coronor's inquests; and to that taken by the Liverpool Local Marine Board, and to the Report of Captain Walker, Royal Navy, given in to the Board of Trade. All these sources of information go to *prove* this at least, that two *adjusted* compasses, which agreed, very nearly, on the ship's leaving port, were found to differ, to an extent of about two points, but two days afterwards. Changes, therefore, must have taken place in this ship's organic magnetism to produce in two compasses, previously agreeing, such a wide difference. But this, obviously, was but a part of the actual change. After passing Holyhead, on the morning of the fatal Saturday, the courses of the ship, as indicated by an adjusted compass, ranged, according to a variety of evidence, from west by south to south-west by south,—courses which should have led the ship well down the Channel. But, as indicated by Capt. Noble's own chart, which I now have before me, and by corrections suggested by intelligent and competent, but uninterested, persons at Liverpool, the entire change in these two compasses (as determined finally by the stranding on Lambay Island) must have extended to some two or three points in one, and four points,

or more, in the other! And such a change as this, as we shall hereafter, I believe, see, is not out of range of probability on scientific grounds.

Sudden changes of an appreciable, and sometimes considerable, quantity in a ship's magnetism are shown in Vol. II. of my "Magnetical Investigations" (page 416) to be by no means infrequent. In the *Ripon*, from Alexandria to Southampton, in May, 1848, a sudden change is noted in the Captain's "compass observations," after the passing of Cape Finisterre, in these terms:—"This sudden alteration in the variation led us fifteen miles to the east of our course, so as to make Ushant on the port bow!" The sudden change in the case of the *Ottawa* is already before us. And numerous others might be adduced, if we were to take in here the cases of ships first rounding the Cape of Good Hope to the eastward. And, besides all this, the fact of a change, great and sudden, in the case of the *Tayleur*, stands on evidence, which, taken without preconception of theory or the prejudicing influence of particular personal views, could not be questioned.

III. *Whether, with reference to any such rapid or sudden change, as has been asserted of the Tayleur's compasses, we may assume, "speaking with our present knowledge of the subject, that it is not possible?"*—If I were to meet this opinion by the mere expression of a contrary one, it would obviously serve no useful end. But, by reference to unquestionable scientific principles, combined with actual experiments on iron ships, I hope to be able to do more—to prove, perhaps, that our *present knowledge* should indicate the very opposite view to that taken by Mr. Airy.

In "Magnetical Investigations," Vol. II., published in 1852, and in public lectures at the United Service Institution, &c., on the compasses in Iron Ships, delivered the same year, it was shown, that every ship's original magnetic distribution must have specific reference to her position whilst building; and that the vast power of retentive magnetism, necessarily developed by the mechanical violence of hammering and adjusting the plates and frames of the ship, must take the direction, proximately, of the earth's inductive action. Hence the axial line in the centre of the ship should be expected to pass through, or near to, the general centre of gravity of the body of iron, in the direction of the magnetic dip. On this theory, as illustrated by diagrams, it was shown, that a ship built with her head eastward should have her axial line leaning, at its upper extremity, to the starboard side; with her head westward, to the port side; northward, towards the stern; southward, towards the head. It would follow, of course, that the plane of the magnetic equator would likewise be correspondingly oblique, and lie at right angles (or so tend) to the axial direction. And it was inferred, that this extreme obliquity of the magnetic arrangement could not, on occasions of powerful mechanical violence with the ship's head in *new positions*, remain permanent. The *quantity* of the magnetism developed by mechanical action, it was evident, could undergo little or no change whilst the ship remained in or near the same magnetic latitude,—nor would the *upright* iron—constituting the largest proportion of the magnetic material—be liable to change in these regions; but the *horizontal* iron must be liable to have its polarity altered, and the polar axis of the ship must be liable to be changed. For mechanical violence or vibration, however it might be

produced, would *tend*, with the ship's head in new directions, to shake down the *oblique* arrangements of the polar axis and the equatorial plane into a *vertical axis and horizontal equatorial plane.* Hence, unless the magnetic arrangement developed by mechanical violence could be supposed to be beyond the control of mechanical violence under new directions of terrestrial induction,—the conclusion on scientific principles was inevitable, that the ship's original organic magnetism must shift or change.

Having thus shown that the present state of our knowledge leads, on theoretic considerations, to the conclusion that a ship's original magnetic arrangement would change—a conclusion, indeed, which I sought to establish in a paper on this very subject at the Meeting of the British Association at Oxford, in 1847,—it will be my object to show next week the correctness of the theoretic deductions by actual facts of experiment on iron ships.

WILLIAM SCORESBY.

Torquay, Dec. 4.

(To be Continued.)

Specification of the Patent granted to JAMES A. CUTTING, *of Boston, in the United States of America, Photographer, for an Improved Process of taking Photographic Pictures upon Glass, and also of Beautifying and Preserving the same.*—[Dated London, July 26, 1854.]*

This invention consists in an improved process of taking photographic pictures upon glass, and also of beautifying and preserving the same, which process I have styled "ambrotype." My improved process has reference to the art of taking pictures photographically on a film of collodion upon the surface of a sheet of glass, the collodion being suitably prepared for the purpose. By the use of the said process, the beauty and permanency of such pictures are greatly increased, and I have on this account styled the process "ambrotype," from the Greek word ambrotos, immortal.

The first part of my invention consists in the use of alcohol, for the purpose of depriving the gun-cotton, of which the collodion is made, of its moisture after it has been washed, to free it from the acids used in its manufacture.

It has been found that where gun-cotton has been exposed to the action of the atmosphere for the purpose of drying it, the sensitiveness of the collodion prepared from it is sensibly diminished. By the use of alcohol it may be deprived of its moisture after being washed, without exposure to the air, and without the consequent deterioration of its sensitiveness. This part of my process I conduct as follows:—So soon as the cotton has been sufficiently exposed to the acids and has been thoroughly washed, it is plunged into strong alcohol, which effectually deprives it of the water which it contains, without exposing it to the atmosphere for the purpose. From this alcohol it is taken immediately to the mixture in which it is to be dissolved for the purpose of forming the collodion. This mixture consists of ten parts of sulphuric ether and six of alcohol, or

* From the Repertory of Patent Inventions, April, 1855.

thereabouts. The collodion thus formed is allowed to remain until it has settled perfectly clear, which usually requires about twenty-four hours. It is then decanted, and to every pint is added eighty grains of iodide of potassium dissolved in alcohol. It is then well shaken, and thirty-two grains of refined gum camphor is added to each pint of the collodion, and after it has again settled it is fit for use. The object of the camphor is to increase the vigor and distinctiveness of delineation of the positive pictures, and particularly of the half tints. It also greatly increases the beauty of the picture, by giving a fineness of deposit not heretofore attained by any other means. The use of the gum camphor in the manner above described forms the second branch of my invention. The collodion is then applied to the surface of the glass in the following manner:—

The plate of glass being held horizontally, a portion of the collodion is poured upon it, and it is then inclined in different directions, so as to cause the collodion to flow over its whole surface, upon which it forms a colorless transparent film; the excess of collodion is then allowed to run off, and the glass, being still held horizontally, is inclined to one side and the other, until the collodion becomes partially thickened or set. When this has taken place, and before it is dry, it is rinsed in a solution of crystallized nitrate of silver, of a strength of forty grains to the ounce of water; the film is thus impregnated with iodide of silver, and after remaining in this bath a sufficient length of time for the ether to escape from the collodion, the plate is ready to be placed in the camera. After being exposed a sufficient length of time in the camera, it is taken to a dark room, where the latent picture is developed, by the application of a solution of protosulphite of iron, acetic acid, and nitric acid, in about the following proportions:—One quart of soft water, one ounce protosulphite of iron, thirty-two drachms No. 8 acetic acid, one drachm nitric acid. These exact proportions are not rigid, but I have found them to be sufficient for the purpose of developing the picture. After this is accomplished it is washed in clean soft water, and then the remaining iodide of silver is dissolved from the collodion film by a solution of hyposulphite of soda, after which the picture is entirely cleansed of the hyposulphite solution by washing as before, in soft water. The picture is then dried, either in the open air or by the aid of a gentle heat, and the process is completed.

To permanently improve the beauty of the pictures, and to deprive them of a bluish, hazy, indistinct look, is the object of my third improvement; which consists in the application of a coating of balsam of fir to the surface of the glass upon which the picture is made, the balsam being confined to the picture plate by a secondary plate of glass, which is applied to the picture plate in a manner which will now be described, and which hermetically seals up the picture and protects it from every and any injury not sufficient to fracture the glasses themselves. This part of the process will now be described.

A second plate of glass is prepared of the same size as that which carries the picture, and is thoroughly cleansed; the picture plate is then held horizontally, the picture side uppermost. The balsam is then applied in a line along one edge of the glass, and one edge of the secondary plate is then applied to the edge of the first, which contains the balsam. The

two plates are then pressed gradually together, by which the balsam is caused to flow entirely across the picture towards the opposite edge, and the air is effectually excluded from between the plates. The superabundant balsam is then removed by pressing the glasses together, and a thin coating of it only is left upon the surface of the picture. The beauty and distinctness of the pictures are greatly enhanced by this application, the finer lines as well as the dark portions and shadows being rendered far more distinct, and the most minute delineations being brought out and made visible, while the application of the second plate of glass secures the whole from the action of air, moisture, and dust.

What I claim as my invention, is,

1st. The method of depriving the gun-cotton of its moisture by the use of alcohol, whereby the sensitiveness of the collodion prepared therefrom is preserved unimpaired.

2d. The use of gum camphor in the preparation of collodion for the purpose set forth.

3d. I am aware of the previous use of balsam for the purpose of cementing together lenses, and also of securing microscopic objects, and I therefore lay claim to no such use.

But what I do claim, is, the application of the balsam to the surface of photographic pictures upon glass, in combination with the method described of protecting and securing the same by means of the additional plate of glass.

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*Compass Variation and Collisions at Sea.**

The following is an extract from a letter of Lieutenant Maury's, which was read before a meeting of the managers of the Life Saving Benevolent Association:

"National Observatory, Washington, Nov. 7.

"Dear Sir,—I received, by due course of mail, your note with an account of the proceedings which took place before the British Association, concerning the errors of ships' compasses.

"There is a liability of the ships' compass to error, which none of the rules as yet laid down seem sufficient to detect, and it appears to have been an error from this source which led to the loss of the *Tayleur*.

"Magnetists have not been able to devise any plan for preventing or detecting these errors at all times. They can, however, be always detected when the sun or the stars are out, and in cloudy weather a close attention to the mariner's three L's, (log, lead, and look-out,) will go far towards preventing mischief.

"Every vessel, and especially those in the European and Californian trade, should be provided with an azimuth or standard compass; and whenever sights are taken for chronometer, observations should also be made for variation. For this purpose a place near the middle of the quarter of hurricane deck, and as far from any iron as possible, should be marked, and upon that spot the azimuth compass should always be placed when an azimuth or amplitude is to be taken; and on every such occasion the heading of the ship, both by the standard and the steering compass, should be noted, entered in the log, and allowance made according

* From the Mechanics' Magazine, December 1854.

thereto for the courses steered by the binnacle or steering compass. The difference between these two compasses will be greater on some courses than on others. But most American navigators know the cause of this difference, how to detect it, and how to allow for it; and therefore it is unnecessary further to allude to the subject of 'Local Deviation.'

"In addition to these precautions, a 'tell-tale' compass under the fore or maintop would be further removed than any of the compasses below, from the varying magnetism of the vessel, and I would recommend it especially for steamers, as a useful check. In case of no top, a place might be made especially for its accommodation aloft. I allude to dangers of deceitful compasses on Californian or European voyages especially, because vessels trading thither are so often enveloped in fogs as they near the land by the way; and because we have more steamers plying to those foggy ports than to any others. But what remedy can we provide against the liability to such dreadful disasters as that which befel the *Arctic?* The three L's do not constitute a sure preventive. I have reflected much upon the subject, and I like the ideas of my friend R. B. Forbes, of Boston, better than any I have heard. He proposes a double track across the Atlantic for steamers. By having one route for them to go, and another for them to come, we should not avoid entirely, but we should greatly lessen, the liability of collision. If steamers would agree to follow two such routes, I think I could lay them off so as to have them quite separate except at the two ends, without materially lengthening the passage either way."

Notice of Wood for Bearings of Moving Machinery.

John Penn, the well known steam engineer, of England, has lately patented the application of wood to bearings for propeller shafts. The inner surfaces of their bearings, being somewhat larger than the shafts, are grooved longitudinally to receive fillets of wood, lignum vitæ, or other hard wood preferred, the grain of which may either be parallel or perpendicular to the surface of the shaft. The grooves are dovetailed in section. The strips or fillets may be 1½ or 2 inches wide and project from the inner surface of the bearing ⅛ or ¼ of an inch; the spaces left between them serve to admit the water, which, it is desirable, should have constant access. Mr. Penn prefers to have the rubbing surface of the shafts of brass.

It is easily perceived that a number of spare fillets being provided, it is an easy affair to renew the bearing when it wears.

The same gentleman has also patented the application of wood to piston packing, stuffing box packing, and the faces of slide valves for steam engines; the usual metallic surfaces, according to this plan, are to be grooved out for the reception of the wood, which is held in by countersunk headed screws.

In the application of shaft bearings, the novelty is in the *mode* of using strips or fillets, which being cheap, readily changed, and admitting the water freely, would, no doubt, be an improvement, as it is known that wood and brass work well together, and that the wood surfaces become highly polished and produce little friction.

With regard to slide valves and pistons, the advantages do not appear to us so marked, as metallic surfaces operate well, and the use of wood would not lessen the expense, still it is an experiment worth trying.

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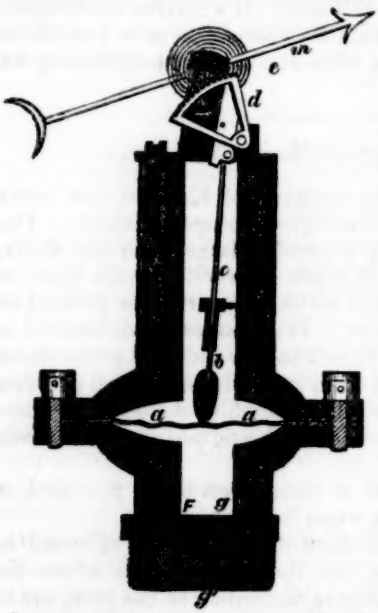
*Schæffer's Patent Steam Gauge.**

The accompanying engraving represents a steam pressure gauge, the merits of which have been spoken very highly of. A′ and A″ are two circular iron plates, between which is fastened by its outer part a steel plate, *a*, *a*, corrugated in circles, round its centre. By means of the jointed parts, *b*, *c*, any motion with which the plate, *a*, *a*, is effected, is transmitted to the rack and pinion, *d*, and thence to the needle or pointer.

The action of the instrument is as follows:—The steam enters through the opening, *g*, which forms a curved channel leading into the hollow, F, and presses upon *a*, *a*, which is covered on the underside by a tin foil covering, *k*, that serves to protect it from rust, and at the same time, to form the joint between A′ and A″. The curves of *a*, *a*, in consequence of their elasticity, are slightly raised by this pressure, and along with them, the parts, *b*, *c*, which transmit the motion to the rack and pinion, *d*, by a multiplication of about 400 times. On the pointer, *m*, is attached a small spiral spring, *e*, which merely serves to keep the rack and pinion, *d*, working on one side. By this arrangement the pressure which slightly moves *a*, *a*, is registered distinctly by the pointer on the dial. The opening, *g*, is preferred to be in a curved direction, for the sake of the steam condensing in going through it, and filling the under part, F, with water, which tends to keep the plate, *a*, *a*, at a low temperature.



The divisions on the dial are made by actual experiment. In order to point out the advantages possessed by this instrument, it has been remarked, that "the very slight motion which the plate, *a*, *a*, has to undergo, keeps it free from the chance of losing its elasticity; whereas, the very large multiplication makes the instrument, nevertheless, sensitive in the very highest degree, so that the slightest variation in pressure will show itself more distinctly. The simple contrivance, *b*, *c*, *d*, forming the transmission, and an entirely firm connexion between the plate and the pointer, keeps the instrument in a steady action without allowing any back-lash, or other motion of the pointer which is not caused

* From the Mechanics' Magazine, December 1854.

by the actual pressure. The incasement is made so strong and solid, that no dust or any thing that might hinder the transmission in its action is allowed to enter, whereas, the plate, *a*, *a*, itself, forms a hermetical joint, preventing any thing entering beyond the hollow, F. Another consequence of the large multiplication adapted to this instrument is, that the pointer, by necessity, must return to zero after the pressure has subsided, so long as the plate has not lost its elasticity. By this means the pointer itself gives a control over the veracity of the instrument, as it is a matter of impossibility that the former could return to its starting place if the position of the plate was only to change by the breadth of a hair.

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*On the Manufacture of Steel.**

(Continued from page 136.)

From this description of the process, it will be evident that pig iron will require a much longer time to decarbonize than the cakes of metal which have been roasted, as already described; and, again, it must be evident that a *purified* and *decarbonized* metal, such as I have proposed, must be the best to secure a good and equal quality to the steel, since the purified metal is more homogeneous than the crude iron.

When, therefore, care has been taken in melting down each portion of metal, and a complete and perfect layer of steel has been obtained after each successive melting, when the cinder has had due attention, so that it has been neither too thick nor too thin, and the heat of the fire regulated and modified during the progressive stages of the process, then a good result is obtained; a fine grained steel is produced, which draws under the hammer and hardens well. However good it may be, it possesses one great defect; it is this. During its manufacture, *iron* is produced along with the steel, and becomes so intimately mixed up with it, that it injures the otherwise good qualities of the steel; the iron becomes, as it were, interlaced throughout the mass, and thus destroys its hardening quality. When any tool or instrument is made from natural steel, without it has been very well refined, it will not receive a *permanent* cutting edge; the iron part of the mass, of course, not being hard, the tool cuts only upon the steel portion; the edge very soon, therefore, becomes destroyed. There is another defect in natural steel, but it is of less importance. When too much carbon has been left, the steel is raw and coarse, and it draws very imperfectly under the hammer; the articles manufactured from such steel often break in hardening; thus it is evident, that in producing the steel, every care, skill, and attention are required at the hands of the workman. These defects very materially affect the commercial value of the steel; the irregular quality secures no guarantee to the consumer that the tools shall be perfect, and, consequently, it is not used for the most important purposes; yet, where the raw steel is refined, it becomes a very useful metal, and is largely used in Westphalia for the manufacture of hardware, scythes, and even swords. It possesses a peculiarity of retaining its steel quality after repeated heating, arising from its carbon being, as it were, incoporated with *each* molecule of the

* From the Lond. Mechanics' Mag., May, 1855.

mass. This property renders it very useful for mining and many other purposes.

The raw steel, being so imperfect, is not considered so much an article of commerce with the manufacturer, but it is sold to the steel refiners, who submit it to a process of welding. The raw steel bloom is drawn into bars, one or two inches wide and half an inch thick, or less; a number of these are put together and welded; these bars are then thrown into water, and they are broken in smaller pieces to examine the fracture; those bars which are equally steelified, are mixed together. In manufacturing refined steel, the degree of hardness is selected to suit the kind of article which it is intended to make. A bar, two to three feet long, forms the top and bottom of the bundle, but the inside of the packet is filled with the small pieces of selected steel. This packet is then placed in a hollow fire, and carefully covered from time to time with pounded clay, to form a coat over the metal, and preserve it from the oxidizing influence of the blast. When it is at a full welding heat, it is placed under a hammer, and made as sound and homogeneous as possible; it is again cut, doubled together, and again welded. For very fine articles, the refining is increased by several doublings, but this is not carried at present to so great an extent as formerly, since cast steel is substituted, being in many cases cheaper.

I take the manufacture of puddled steel as next in order, because the product is similar to that of natural steel, that being obtained direct from the crude pig iron. It is a steel of very recent invention, and its manufacture is carried on entirely in Westphalia. But a few years ago a very small quantity of this steel was produced from *one* work. There are now several large establishments for its manufacture. The produce is becoming considerable, and likely to increase on account of its cheapness.

The object of the operation is similar to that adopted in the making of raw steel, to decarbonize pig iron down to that point at which it can be treated as steel. The process is this:—About 280 lbs. of pig iron are charged into a puddling furnace. As soon as this metal begins to melt, the damper is partly closed, and 12 to 16 shovelfuls of cinder, &c., as it comes from the hammer and rolls, are thrown into the furnace; the whole is then melted down together, and the mass is puddled with great care. The metal having become so far decarbonized as to lose its liquidity, the damper is opened, and 40 lbs. of pig iron are charged near the fire-bridge of the furnace. This is allowed gradually to melt and mix itself with the metal previously charged, which causes it to boil; a blue flame rises from the surface of the mass, and very shortly the metal stiffens. The damper is again three-quarters shut, and the mass is worked until it becomes waxy. The metal is then collected into balls and hammered into blooms. This steel is very imperfect; too much depends upon the manipulation of the process; it is out of the sight of the workman, and equally from under his control, being continually covered with cinder. Practice has, no doubt, assisted materially in the improvements made in the manufacture of this steel since its introduction, but it is evident that steel produced by such a process can only be serviceable for the commonest purposes, being subject to many serious imperfections. The blooms resulting from the process described are drawn, doubled,

and welded precisely in the same manner as charcoal raw steel is refined; yet, such is the acknowledged inferiority of this steel, that whilst charcoal natural steel sells for £18 per ton, the puddled steel will not command more that £14 per ton, and an equal reduction is made on the refined steel manufactured from puddled steel blooms.

The next process is the Paal method, so called, from the name of the works at which the plan is used. These works belong to Prince Schwartzenberg, and are situated near to Murrau, in Styria. The process is based upon the old one of Vanaccio; it consists in plunging iron into a bath of melted metal. The carbon of the metal combines with the iron, and in a very short time converts it into steel. This process was carried further by Vanaccio, who contrived to add wrought iron to the metal until he had decarbonized it sufficiently; this was found to produce a steel, but unfit for general use. That produced by plunging iron into metal, was found to be very hard steel on the outside, but iron within; while that produced by adding iron to the metal was found too brittle to be drawn. The Paal method, however, as I saw it used at these works, is a decided improvement in the manufacture of refined natural steel. They produce natural steel at the Prince's various works, and bring it to Paal to be refined. The packets, as already described in the refinement of natural steel, are welded and drawn to a bar; whilst hot they are plunged into a bath of metal for a few minutes, by which the iron contained in the raw steel becomes carbonized, and thus a more regular steel is obtained than that produced by the common process. The operation requires great care, for if the bars of steel be left in the metal too long, they are more or less destroyed, or perhaps entirely melted. It commands a little higher price in the market, and is chiefly consumed by the home manufacturers, excepting a portion which is exported to Russia.

I have now described the manufacture of steel by various processes, in all of which the carbon is derived from the metal itself, and in which the whole of the molecules of the metal may be said to be equally charged; they contain the necessary amount of carbon, or steelifying principle, within themselves, and to this may be attributed the reason why, after repeated heating and hammering, the steel never loses its property of hardening. On this account, natural steel is used almost exclusively by the Mexican and South American miners for their tools.

I shall now turn to the second mode of producing steel, by introducing carbon into iron to such an extent as may be needful for the various purposes to which it is to be applied.

In explaining the theory and practice of manufacturing natural steel, I have shown that the object is to prevent the mass from becoming iron, the process being arrested at that point where the metal has lost so much of its carbon that the *remainder* is necessary for it to possess as a steel.

The process of converting iron into steel by cementation is the reverse of the process already described. The iron to be converted is placed in a furnace stratified with carbonaceous matter, and on heat being applied, the iron absorbs the carbon, and a new compound is thus formed.

When this process was discovered, is not known. At a very early period charcoal was found to harden iron, and make it a sharper cutting instrument; it seems probable that, from the hardening of small objects, bars

of iron were afterwards submitted to the same process. To Reamur certainly belongs the merit of first bringing the process of conversion to any degree of perfection. His work contains a vast amount of information upon the theory of cementation; and although his investigations are in many instances not borne out by the practice of the present day, yet the *first* principles laid down by him are now the guide of the converter; our furnaces are much larger than those used by Reamur, and they are built so as to produce a more uniform and economical result; they give, however, precisely the same results which he obtained in his small ones.

A converting furnace consists simply of two troughs, built of fire-brick, 12 feet long, 3 feet wide, and 3 feet deep; the fire-room is placed between them, and the whole covered by an arched vault, so that the heat may pass entirely around these troughs, and distribute itself equally. The bar iron is placed within these troughs, stratum superstratum along with charcoal, which is broken to the size of beans. When the troughs are full, they are covered with sand or loam, which partially vitrifies and cakes together as the heat of the furnace increases, and thus, by hermetically sealing the top, the air is excluded. This furnace being charged with about 20 tons of iron, the fire is lighted, and in the course of 60 to 70 hours the iron will have become fully heated; *at this point the conversion commences.* The pores of the iron being opened by heat, the carbon is gradually absorbed by the mass of the bar, but the *carbonization* or conversion is effected, as it were, in layers. To explain the theory in the clearest manner, let me suppose a bar to be composed of a number of laminæ—the combination of the carbon with the iron is first effected on the surface, and gradually extends from one lamina to another, until the whole is carbonized. To effect this complete carbonization, the iron requires to be kept at a considerable uniform heat for a length of time. Thin bars of iron are much sooner converted than thick ones. Reamur states, in his experiments, that if a bar of iron $\frac{3}{16}$ths of an inch thick is converted in 6 hours, a bar $\frac{7}{16}$ths of an inch would require 36 hours to attain the same degree of hardness. The carbon introduces itself *successively*, the first lamina or surface of a bar combining with a portion of the carbon with which it is in contact, gives a portion of the carbon to the second lamina, at the same time taking up a fresh quantity of carbon from the charcoal; these successive combinations are continued until the whole thickness is converted; from which theory it is evident that, from the exterior to the centre, the dose of carbon becomes proportionately less. Steel so produced cannot be said to be perfect; it possesses in some degree the defect of natural steel, being more carbonized on the surface than at the centre of the bar. From this theory we perceive that steel made by cementation is different in its character from that produced directly from crude metal. In conversion the carbon is made successively to penetrate to the centre of the bar, whilst in the production of natural steel, the molecules of metal which compose the mass are *per se* charged with a certain per centage of carbon necessary for their steelification; not imbibed, but obtained by the decarbonization of the crude iron down to a point requisite to produce steel.

During the process of cementation, the introduction of the carbon disintegrates the molecules of the metal, and in the harder steel produces a distinct crystallization of a white silvery color. Wherever the iron is

unsound or imperfectly manufactured, the surface of the steel becomes covered with blisters thrown up by the dilatation of the metal and introduction of carbon between those laminæ which are imperfectly melted. Reamur and others have attributed this phenomena to the presence of sulphur, various salts, or zinc, which dilate the metal; but this is incorrect, because we find that a bar of cast steel which is homogeneous and perfectly free from internal imperfections never blister, for although it receives the highest dose of carbon in the furnace, yet the surface is perfectly smooth. From this it is evident that the blisters are occasioned by imperfections in the iron. Iron increases, both in length and weight, during conversion. Hard iron increases *less* than soft. The augmentation in weight may be said to be $\frac{1}{20}$, and in length $\frac{1}{120}$ on an average.

The operation of conversion is extremely simple in its manipulation; nevertheless, it requires great care, and a long as well as a varied experience to enable a manager to produce every kind or temper required by consumers. Considerable knowledge is required to ascertain the nature of the irons to be converted, because all irons do not convert equally well under the same circumstances; some require a different treatment from others, and, again, one iron may require to be converted at a different degree of heat from another. The furnace must have continual care, and be kept air-tight so that the steel, when carbonized, may not again become oxidized. Generally speaking, in working converting furnaces, but little attention is paid to the theory of producing steel, which I have endeavored to explain. It is known amongst steel-makers, that if iron be brought in contact with carbon, and if heat be applied, it will become steel. This is the knowledge gleaned up by workmen, and, I may add, by too many owners of converting furnaces. The inconvenience arising from a want of care and knowledge of the peculiar state of the iron *during* its conversion, sometimes occasions great disappointment and loss. The success usually attained by workmen may, however, be attributable to an every-day attention to one object, thus gaining their knowledge from experience alone; good, I admit, in a workman, but this should not satisfy the principal or manager of a steel works. It is, perhaps, not needful that he should be a man of science, but I consider it the duty, as it certainly is the interest, of every owner of such works, not only to satisfy himself, but to be able to convince the minds of others, that he is fully conversant with the cause and effect of every operation in his business, and although a knowledge of chemistry may throw much light upon his operation, it is also necessary that he should possess a varied experience in conjunction with it, before he can pretend to produce steel of such superior and uniform quality as the arts require. The conversion or carbonization of the iron, is the foundation of steel making, and, as such, may be considered as the first step in its manufacture. Before bar steel is used for manufacturing purposes it has to be heated, and hammered or rolled. Its principal uses are for files, agricultural implements, spades, shovels, wire, &c., and in very large quantities for coach springs.

Bar steel is also used for manufacturing shear steel. It is heated, drawn to lengths 3 feet long, then subjected to a welding heat, and some six or eight bars are welded together precisely as described in the refine-

ment of natural steel; this is called single shear. It is further refined by doubling the bar, and submitting it to a second welding and hammering; the result is a clearer and more homogeneous steel. During the last seven years the manufacture of this steel has been limited, mechanics preferring a soft cast steel, which is much superior when properly manufactured, and which can be very easily welded to iron.

The price of bar steel varies according to the price of the iron from which it is made, but, as a general average, its price in commerce may be taken at £5 per ton beyond the price of iron from which it is made. Bar steel produced from the better irons is usually dearer than the commoner kind, on account of their scarcity.

Shear steel in ordinary size sells at £60 per ton nett.
Coach spring steel from foreign iron, £22 per ton nett.
Coach spring steel from English iron, £18 per ton nett.
These may be taken as approximate prices in 1854-5.

From the outline which I have given of the processes by which various steels are manufactured, it will be seen that there are in each great defects, want of uniformity, temper, or clearness of surface, unfitting them for many useful purposes. To obviate these defects, both bar converted and also raw steel are *melted*, by which the metal is freed from any deleterious matter which the iron might have contained; a uniform and homogeneous texture is obtained, whilst an equality in temper or degree of hardness is secured; besides which, the surface is capable of receiving a high, clear, and beautiful polish—qualities which the other steels I have described do not possess. The first steel which may be called cast steel is the celebrated wootz or India; it is produced by mixing rich iron ore with charcoal in small cups or crucibles. These are placed in a furnace, and a high heat is given by a blast. After a certain time this ore melts and receives a dose of carbon from the leaves and charcoal charged with it. The result is a small lump of metal with a radiated surface about the size of a small apple cut in two; it is very difficult to work; nevertheless, swords and other steel implements are manufactured from it in the East; it is not found in England as an article of commerce. The melting of bar steel was first practically carried out by Mr. Huntsman, of Attercliffe, near Sheffield, whose son yet carries on its manufacture, for which he enjoys a very high celebrity, by making use of the best materials, and insisting upon the most careful manipulation of his steel in every process. The manufacture of cast steel is in itself a very simple process. Bar steel is broken into small pieces, which are put into a crucible, and are melted in a furnace about 18 inches square and 3 feet deep. The crucible is placed on a stand 3 inches thick, which is placed on the grate bars of the furnace. Coke is used as fuel, and an intense heat is obtained by having a chimney about 40 feet high. Although a very intense white heat is obtained, yet it requires 3½ hours to perfectly melt 30 lbs. of bar steel. When the steel is completely fluid, the crucible is drawn from the furnace, and the steel is poured into a cast iron mould. The result is an ingot of steel, which is subsequently heated and hammered, or rolled, according to the want of the manufacturers. Although I stated that the melting of cast steel is a simple process, yet, on the other hand, the manufacture of cast steel suitable for the *various wants* of those who con-

sume it requires an extensive knowledge; a person who is capable of successfully conducting a manufactory, must make himself master of the treatment to which the steel in manufactures will be submitted by every person who consumes it. Cast steel is not only made of many degrees of hardness, but it is also made of different qualities; a steel maker has, therefore, to combine a very intimate knowledge of the exact intrinsic quality of the iron he uses, or that produced by a mixture of two or three kinds together; he has to secure as complete and as equal a degree of carbonization as possible, which can only be attained by possessing a perfect practical and theoretical knowledge of the process of converting; he has to know that the steel he uses is equal in hardness, in which, without much practice, he may easily be deceived; he must give his own instruction for its being carefully melted, and he must examine its fracture by breaking off the end of each ingot, and exercise his judgment whether or not proper care has been taken; besides all this knowledge and care, a steel maker has to adapt the *capabilities* of his steel to the *wants* and *requirements* of the consumers. There are a vast variety of defects in steel as usually manufactured; but there are a far greater number of instances in which steel is *not adapted* for the manufacture of the article for which it was expressly made. Cast steel may be manufactured for planing, boring, or turning tools; its defects may be, that the tools when made crack in the process of hardening, or that the tool whilst exceedingly strong in one part, will be found in another part utterly useless.

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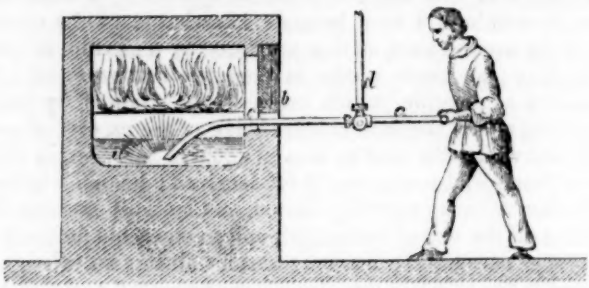
*Improvement in Puddling Iron.** By JAMES NASMYTH, Patricroft, Manchester, England. Patented May 4, 1854.

Patented in the United States. Merrick & Sons, Assignees, Philadelphia, Pa.

This invention relates to a process of puddling iron, whereby not only will the disengagement of the carbon from the molten metal be greatly expedited, but the quality of the iron will also be considerably improved. In carrying out this invention, the molten cast iron in the puddling or refining furnace is subjected to the action of a current or currents of steam, introduced, as nearly as practicable, to the lowest portion of the molten iron, and thence diffused upwards, so as not only mechanically to agitate the molten iron, and thereby keep exposing fresh surfaces of the iron to the oxygen contained in the atmosphere passing through the furnace, but also, when brought in contact with the incandescent iron, to be reduced to its elements, and yield oxygen, which will chemically combine with the carbon of the iron, as well as with the sulphur or other oxidizable substances of the iron with which it may come into contact and have affinity, and thereby deprive the iron of those impurities; whilst the other component of the steam, simultaneously liberated (namely, hydrogen), is free to combine with any sulphur present in the furnace, whether as an ingredient in the iron, or as a product of combustion of the fuel employed for heating the iron; and thus, substances very prejudicial to the quality of the iron will be removed or prevented from combining therewith; whilst, at the same time, the operation will be materially expedited.

* From the Civil Engineer and Architect's Journal, April, 1855.

The engraving represents in cross section, an ordinary puddling furnace, suitably fitted for carrying on the puddling operation according to this invention. *a*, represents the molten metal in the basin of the furnace; *b*, the rabble-hole in the furnace door; and, *c*, a bent pipe, the forward



end of which is admitted into the furnace through the rabble-hole, and which is shown of equal diameter throughout. This pipe *c*, is attached by a universal joint to a pendant-pipe *d*, in connexion with a steam-boiler, and is intended to conduct a current of steam beneath the surface of the molten metal. Affixed to the rear end of the pipe *c*, is a handle *e*, by means of which the attendant is enabled to direct the orifice of the pipe to any part of the bed of the furnace.

Claim.—Operating upon molten iron in the manner and for the purposes set forth.

Improvement in the Manufacture of Cast and Malleable Iron. *

Prof. Frederick Grace-Calvert, of Manchester, has patented an invention, the object of which is to obtain a better quality of cast and malleable iron from certain iron slags or cinders, known by the names of puddling, refinery, and heating slags or cinders, than is effected at the present day. The usual way of applying these slags or cinders on a blast furnace consists in adding them, either alone or mixed with ironstone, without submitting them to any previous preparation, except sometimes burning them in a heap. The consequence is, that as they descend in the furnace they are soon carried to a bright red heat and fused, and get mixed with the various materials which compose the charge of a blast furnace. A portion of these slags or cinders, falling on mine or coke, is not fluxed, and thus gradually finds its way to that part of the furnace where cast iron is being produced, and uniting with it, descends into the cupola or the blast furnace. It is easy to understand how the above iron slags or cinders, mixing themselves with the cast iron, injure its quality, for iron slags or cinders are chiefly composed of silicate, sulphuret, and phosphuret of iron, which act most injuriously on the quality of cast and malleable iron.

The mode of operating, so as to effect the complete fluxing of the above slags or cinders, and thus prevent the silica, sulphur, and phosphorus

*From the London Mining Journal, No. 1034.

arriving in contact with the cast iron which is being produced, is as follows:—The first process consists in reducing the above puddling, refinery, and heating furnace slags or cinders into coarse powder, which is done by any of the ordinary mills and grinding apparatus now in use, and then adding to them about one-half their weight of slaked lime, made into a thick paste. They are then well mixed together, and the mass is made into lumps or bricks of a convenient size, which are dried or not, according to circumstances, previously to adding them at the top of the blast furnace; or the dried lumps of lime and slag or cinders may be calcined in a separate furnace, and afterwards introduced, with ordinary mine, at the top of the blast furnace; or the mass of lime and slag may be mixed with coal, coke, or charcoal, and calcined in a furnace, or introduced into crucibles, and thus separate the iron which it contains previously to its addition on the blast furnace. The patentee remarks, that heating slags or cinders generally, do not requir eroasting, but that refinery and puddling slags often do.

The second process consists in roasting or oxidizing the iron slags or cinders before they are mixed with slaked lime. To oxidize these slags or cinders two different processes are adopted. The slags are reduced to fine powder, and introduced into an oxidizing furnace, such as is used for roasting copper ores; and whilst the powder is carried to a dull red heat it is well stirred, so as to transform the iron or the protoxide of iron it contains, into peroxide, the silicum into silica, the prosphurets into phosphates, and the sulphur into sulphurous acid. When the powder has assumed a bright red color, and no more sulphurous acid is produced, it is taken out of the furnace and mixed with slaked lime, and applied as above described.

The same purpose is attained by breaking the slags or cinders into small fragments, and introducing them with a small amount of coal into an ordinary kiln, or in one made of four walls which have numerous holes in the sides; the object of which is to admit freely the oxygen of the atmosphere, and which holes are also employed to remove the oxidized slags or cinders. These kilns are worked like ordinary limekilns—viz., the slags or cinders, mixed with a small quantity of coal, are constantly added at the top, whilst the oxidized slag or cinder is removed at the bottom by the opening or openings which exist there, and then the prepared slags or cinders are treated with slaked lime, as before described.

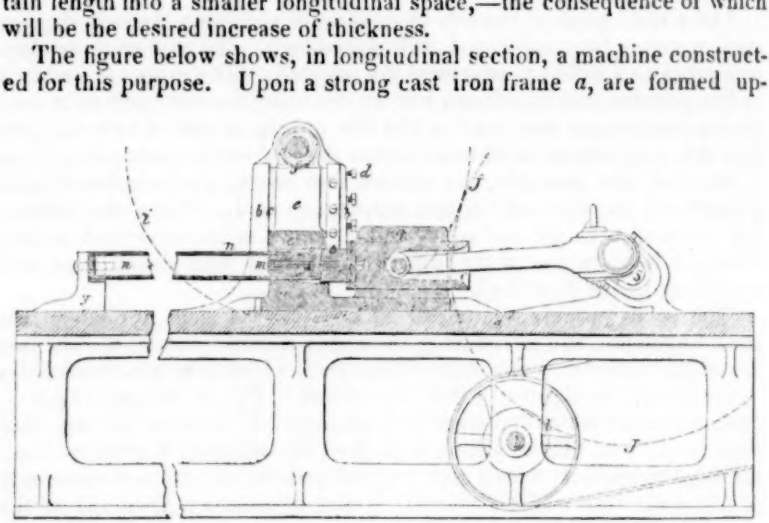
The third process to which the patentee submits puddling, refinery, or heating slags or cinders, is to reduce them into a powder, and introduce them into furnaces which communicate with the blast furnace by means of long flues, into which the volatile products given off from the mouths of the blast furnace or of the coke oven are passed. When the powdered slags or cinders are not sufficiently heated by the gases for these to act upon the component parts of the slags or cinders, a gentle heat is applied, so as to carry them to a dull red heat; then the silicates of protoxide of iron are decomposed, and metallic iron is produced. When the operation is completed, they are taken out and allowed to cool. Such reduced slags or cinders having been made into powder, are to be treated with slaked lime, in manner before described.

The patentee claims the use of hydrate of lime, or slaked lime, in combination or intimately mixed with heating, puddling, and refinery iron slags or cinders, both before and after calcining the latter.

Improvements in Strengthening the ends of Tubes to be attached to Boiler Plates, or to be used for other such Purposes. Patented by WILLIAM BECKETT JOHNSON, of Manchester, England.—[March 9th, 1854.]*

These improvements relate to a method of obtaining a thickened end or ends to tubes, whereby they may with greater security be attached to boiler plates or other apparatus to which metal tubular passages are required to be fixed. To effect this, the tube is manufactured by an ordinary method, and is compressed at the end or ends, so as to force a certain length into a smaller longitudinal space,—the consequence of which will be the desired increase of thickness.

The figure below shows, in longitudinal section, a machine constructed for this purpose. Upon a strong cast iron frame *a*, are formed up-



right parts, one of which is shown at *b*,—the other being at the opposite side, and removed, in order to show the parts in section. Upon these uprights are formed V-guides *c*, one to each standard,—being made adjustable by set screws *d*; and within them is situate a sliding-piece *e*, capable of being forced downward by a cam *f*, and carried upward by an eccentric *g*, situate within a sling formed upon the top of the sliding piece *e*. The cam *f*, and eccentric *g*, are both upon a shaft *h*, receiving rotary motion by the wheels *i*, *j*, the latter of which is driven from the main shaft *k*, by means of a pinion *l*. The sliding piece *e*, extends downwards to the dotted line *m*, and is of a semicircular interior form, so as to extend around one-half of the tube represented at *n*, under operation: the other half of the tube is in like manner surrounded by a

* From the Journal of Arts and Sciences, May, 1855.

bottom die *o*, fixed to the stationary frame-work *a*, and both are chamfered out at *p*, so as to form a cavity corresponding in figure to the intended thickened end of the tube. Upon the frame-work *a*, is mounted a guide *q*, within which is situate a sliding piece *r*, caused to move to and fro by the action of a crank formed upon the shaft *s*. The sliding piece *r*, is continued by circular parts *t*, *u*, of two diameters, which are split in the direction of their length, so as to enable the part *u*, to be expanded or contracted as regards its diameter. Upon the guide *q*, are formed two projecting pieces *v*, *v*, carrying a cottar pin *w*, which passes through a rod *x*, situate within a circular recess formed in the parts *u*, *t*. The rod *x*, is slightly conical, being of larger diameter at its outward end, and will therefore, at that part, keep the split portion *u*, expanded. At one end of the machine are two projecting parts, one of which is shown at *y*; and between them is a cross piece *z*, capable of being turned over on a centre pin, so as to leave the space between the two parts *y*, open. The operation of the machine is as follows:—According to the position shown in the figure, the end of the tube previously heated is about to be compressed into the recess *p*, for which purpose the slide *r*, will be caused to advance by the crank *s*, and will carry forward the part *t*,—during which movement the split mandril *u*, by sliding upon the conical rod *x*, will become expanded, and form an interior support for the tube. The die *e*, previously to this, will have been forced down by the cam *f*,—a dead run upon the periphery of which will retain it in that position, and, while forming the die for the intended thickened end, will serve to prevent a longitudinal motion of the tube: but this may further be secured by the cross piece *z*, the standards of which should be adjustable for different lengths of tube. The heated end having been forced into the dies by the advance of the part *t*, and caused to assume the shape of the dies at *p*, *p*, a smaller diameter of the cam *f*, will allow the top die *e*, to be raised by the action of the eccentric *g*: at the same time the crank *s*, will withdraw the mandril *u*, and cause it to slide back along the fixed rod *x*, and, as it passes on to a smaller diameter thereof, will contract, by reason of its split construction, so as to leave the tube free from interior pressure and enable it to be withdrawn: in order to do which, the cross bar *z*, is turned over upon its centre,—thereby leaving the space between the uprights *y*, free. The split mandril *u*, by now occupying a position upon a smaller diameter of the rod *x*, and being, therefore, of slightly less diameter than the tubes under operation, will enable the heated end of another to be applied and operated upon, as above described. As the rod *x*, does not partake of the sliding motion of the mandril *u*, *t*, the latter is hollowed out at *i*, for a sufficient distance for its reception, and a horizontal slit is also formed in it for the cottar *w*. The thickened end may be formed at one operation, or by repeated compressing operations in dies of gradually increasing dimensions, or by successive compressions in the same dies. The patentee remarks that he contemplates using the direct action of steam for pressing or "jumping up" the ends of the tubes. In reference to the purposes to which the improved tubes may be employed, he states that they will be found of advantage in all cases where such articles have to be united to plates, as in steam boilers, refrigerating or heating apparatus, &c., also where tubes have to be joined to each

other with or without intervening sockets,—as gas-pipes, and steam or air-pipes.

The patentee claims the formation of a thickened end or ends to tubes by pressing or jumping up a portion of their length.

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*Arched Bulkheads for Iron Steamers.**

In the disasters which have happened to steamers during the past year, you cannot have failed to notice that the bulkheads, constituting the water-tight compartments, have usually burst at the very and only time when their services were needed. This may have led to a doubt as to whether they might be depended upon at all as a means of safety, in case the vessel should be stove and one of her compartments filled. But looking at their present system of construction, that is, a flat surface nearly unsupported in a fore and aft direction, it is a wonder that they have in any case been able to withstand the pressure of a column of water equal to the vessel's immersion when laden, increased by the filling of a compartment, aggravated, too, by the pitching motion of the vessel.

To make the bulkheads strong enough to withstand the pressure and motion of the water, I suggest that they should be shaped to the form of an arch, springing from the sides across the vessel. They may be made with either the convex or concave side towards the bow, but the former arrangement is to be preferred, as the vessel is most liable to receive injury forward, and the pressure of the water on that side cannot force the bulkhead out of shape.

March, 1855. KENNETH.

The New Iron Screw-Propeller Steam Transport-Vessel "Sovereign. †

Built and fitted by Messrs. Lawrie & Co., Iron Ship-builders and Engineers, White Inch, Glasgow, 1854.

DIMENSIONS.—			
Length on deck,		196 feet	·8
Breadth at two-fifths of midship depth,		24	·9
Depth of hold amidships,		18	·1
Length of engine room,		45	·3
" of shaft space,		67	·0
Breadth of "		1	·8
Depth of "		1	·9
TONNAGE.—			
Hull,		602	·24
Engine room,	220 ·95	222	·99
Shaft space,	2 ·04		
Register,		379	·25

Fitted with a pair of geared angular engines, of 100-horse nominal power: diameter of cylinders, 40 inches; length of stroke, 3 feet; having reversing gear. Screw propeller: diameter, 11 feet 6 inches; pitch, 11 feet 6 inches; two blades. One tubular boiler, fired fore and aft: length

* From the Lond. Practical Mechanics' Journal, April, 1855.
† From the London Artizan, April, 1855.

at roof, 17 feet 6 inches; ditto at furnaces, 16 feet; breadth, 10 feet 3 inches; depth, 9 feet 6 inches. Steam-chest: length, 12 feet 6 inches; breadth, 5 feet; depth, 5 feet 3 inches. Six furnaces, three at each end of boiler: length, 6 feet 6 inches; breadth, 2 feet 8 inches; depth 2 feet 11 inches. 230 cubic feet in steam-chest. 456 brass tubes, or 228 at each end of boiler; diameter, $2\frac{7}{8}$ inches, and 6 feet long. Chimney: diameter, 3 feet 6 inches, and 24 feet long. Contents of coal bunkers, 120 tons. Weight of engines, 70 tons; ditto of boiler and water, 30 tons; ditto of iron hull, 200 tons; ditto of wood, &c., 150 tons. Launching draft of water forward, 7 feet; ditto aft, 9 feet 10 inches; displacement, 450 tons. Stem, 6×2 inches; sternpost, 6×4 inches; frames, $4 \times 3 \times \frac{7}{16}$ inches, and 18 inches apart. Twelve strakes of plates from keel to gunwale, tapering in thickness from $\frac{5}{8}$ to $\frac{3}{8}$ of an inch. Launched on 14th January, with all the machinery on board. Trial-trip, February 5th, engines making 38 revolutions per minute; steam pressure 15 lbs. The speed of the vessel was 14 miles with tide, and $10\frac{1}{2}$ against ditto; draft of water forward, 9 feet 6 inches, and 11 feet 6 inches aft. Consumes 15 cwt. of coals per hour; has six bulkheads. Employed in the Black Sea, &c.; $604\frac{3}{94}$ tons O.M.

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*Improvement in Screw Steam Machinery.**

A very simple but effectual plan has recently been introduced by Mr. Penn, the eminent engine maker, for preventing that constant and excessive wear and tear of the bearings on the shafts of screw steamers which has hitherto been found so great a practical difficulty and so continually recurring a source of expense. He introduces between the bearing and the shaft, thin slips of wood, which have the remarkable property of entirely suspending that incessant waste of material which, after a certain pressure on the square inch has been attained, is constantly in progress. This simple expedient has been adopted in the recent repairs of the *Himalaya*, and will probably be applied, if found successful in her case, to all screw steamers. While the surface of the bearing is preserved from waste, singularly enough the slips of wood show no indication of being rubbed away or heated.—*Nautical Standard.*

Notice of Colt's Revolver Factory.†

If we were to describe the factory (we can scarcely call it *manu*factory, the hand has so little to do in it), which Colonel Sam Colt has set up at Thames-bank for the production of "Revolvers," fully as it deserves, we should be led perhaps a little too far out of our more particular track: for a few memoranda, however, we *must* find room. It is so well ordered, so complete, so striking in its results, that all engaged in manufacture may learn something from it: it is itself one large machine, well oiled too, which takes in at one end a shapeless lump of iron and a piece of wood, and puts out at the other a beautifully finished arm, which you may load and fire six balls from separately in three-quarters of a minute, after a

* From the Lond. Artizan, April, 1855. † From the Lond. Builder, March, 1855.